COAL FOR THE 70'S: PENNSYLVANIA ACTION

Summary and Recommendations

of

Five Engineering Task Force Reports

and

Four Coal Task Force Reports

April 3, 1974

GOVERNOR'S SCIENCE ADVISORY COMMITTEE

COMMONWEALTH OF PENNSYLVANIA

April 10, 1974

TO: Participants In April 24 Meeting in Harrisburg on Coal for the 70's: Pennsylvania Action

FROM: T. G Fox

Enclosed are drafts of nine Task Force Reports being prepared to advise Governor Shapp and Lt. Governor Kline on how Pennsylvania can increase the use of coal in the 70's. The reports are presented here for your critical examination and discussion at the April 24 meeting. The purpose of our meeting is to insure that the information given to the Governor is correct and complete and that the advice presented is sound. Certain of the Coal Task Force Groups have not finished their deliberations, and it is possible that all the groups will wish to amend their reports in response to the fuller discussions of the April 24 meeting.

Quite possibly, some errors crept into these reports in the haste to meet this mailing deadline. The membership lists for individual task forces may not be correct; in many instances, the members listed from government were present to provide information rather than as full participating members contributing to a consensus.

A summary of the task force reports and other background material are enclosed for your convenience. You will receive a copy of the final program and your registration badge in a separate mailing in a few days.

Please read the Task Force Reports since we do not intend to make full presentations of these on the 24th.

The success of the meeting is dependent on the critical comments and suggestions we receive from you, either orally or in writing. Please use the enclosed sheet to record your comments and either mail them to us or put them in the suggestion box at the meeting.

I know that Governor Shapp, Lt. Governor Kline and Dr. Falkie, Director of the Bureau of Mines, are greatly interested in the feedback from the meeting. I am certain that the Commonwealth's policies and programs in this area will be directly influenced by your advice.

Sincerely,

TGF:mlr

Thomas G Fox

"COAL FOR THE 70's CONFERENCE"

Your comments on the topics presented at this meeting are earnestly solicited. Please comment on this form and deposit at the box by the door or mail to the address below.

COMMENTS:

PARTICIPANTS NAME AND ADDRESS:

PLEASE SEND TO:

"Coal for the 70's"
Room 400 South Office Building
Harrisburg, Pennsylvania 17120

COAL FOR THE 70's: A PENNSYLVANIA ACTION CONFERENCE

8:30 A.M.	Registration	
9:00 - 12:00	General Session	
	Honorable Ernest P. Kline - Presiding Lieutenant Governor	
9:00 - 9:10	Honorable Ernest P. Kline Lieutenant Governor	"Pennsylvania's Energy Strategy"
9:10 - 9:45	Do We Need More Coal for the 70's?	
	Dr. N. J. Palladino Dean, College of Engineering Pennsylvania State University	Why coal? Why not oil, gas, nuclear power, wood or wastes?
	Mr. Albert E. Smigel Director, Bureau of Research & Planning Pa. Department of Commerce	Who needs more coal? How much? How soon? Where? Why?
	Mr. William Poundstone Executive Vice President Consolidation Coal Company	Is there now a long-term growth market for coal in Pennsylvania?
Invited Comments	Mr. Stanley Shaffer President Duquesne Light Company	
	Mr. Jesse F. Core Vice President for Coal Operations U. S. Steel Corporation	
9:45 - 10:20	Can We Do It?	
	Dr. Charles J. Potter Chairman of the Board Rochester & Pittsburgh Coal Company	Can we increase bituminous production? How? How much? How soon? Where?
	Mr. Charles G. Zink Vice President Blue Coal Corporation	Can we increase anthracite production? How? How much? How soon? Where?
	Honorable Walter G. Arader Secretary Pa. Department of Commerce	Does a growth market exist? Is risk capital available?

Invited Comments	Mr. Otis Bennett, Jr. President & Chief Executive Officer North American Coal Company	
	Mr. Kent McElhattan President National Mine Service Company	
10:20 - 10:40	Coffee Break	
10:45 - 11:15	Do We Have The Manpower?	
	Honorable Paul J. Smith Secretary Pa. Department of Labor & Industry	Are the men and skills available? Will new training programs help?
	Dr. Robert Marovelli Division Chief for Mining Research Health and Safety U. S. Bureau of Mines	Can we increase production without danger to the miner?
	Mr. John Manton Research & Technical Engineer United Mine Workers Safety Div.	Is mining an opportunity for more Pennsylvanians in the 70's and 80's?
Invited Comments:	Mr. Ben Romero Vice President of Personnel & Safety Public Relations Eastern Associated Coal Company	
	Dr. Robert Stefanko Professor of Mining Pennsylvania State University	
11:15 - 11:45	Can We Transport and Burn More Coal?	
	Honorable Jacob Kassab Secretary Pa. Department of Transportation	Can we transport more coal? How? How much? How soon?
	Mr. Lewis H. Wolfe Project Engineer Day & Zimmerman Corporation	Will we have new or modified facilities to burn more bituminous and anthracite coal?
	Mr. R. W. Dammann Vice President Operations Division Glen-Gery Corporation	What if you need a guaranteed gas supply <u>now</u>?

Invited Comments	Mr. Dwight Koerber Executive Secretary Coal Traffic Bureau of Northern W.Va., Ohio & Western Pa.	
	Mr. Richard Ludwig Director, Central Engineering & Conservation Hammermill Paper Company	
11:45 - 12:15	Can We Keep It Clean?	
	Honorable Wesley E. Gilbertson Deputy Secretary Pa. Department of Environmental Resources	How can we maintain water, land and air quality standards? Will incentives encourage a variety of control technologies?
	Mr. Melville W. Robinson, Jr. Director of Research & Development Dravo Corporation	Will gas stack scrubbers save the day? How soon can they be installed where needed in Pennsylvania?
	Professor Robert Dunlap Professor of Metallurgy Carnegie-Mellon University	What will coal cleaning, weather-responsive supplementary controls, and tall stacks do as aids to cleaner air at an early date?
Invited Comments	Mr. Curtin Winsor President Pa. Environmental Council	
	Mr. David Fyock Director of Resources & Environmental Quality Pennsylvania Electric Company	
12:15 - 12:45	SOCIAL HOUR	
12:45 - 2:00	LUNCH	
	Robert F. Gilkeson - Presiding Chairman of the Board Philadelphia Electric Company	
	Dr. Richard Balzhiser Director for Fossil Fuels & Advanced Systems Electrical Power Research Institute	Coal in the 70's and 80's
2:15 - 3:30	General Session	
	Mr. John Igoe - Presiding Executive Vice President Bituminous Coal Research, Inc.	

2:15 - 2:30	Dr. Thomas V. Falkie Director U. S. Bureau of Mines	Coal for the 70's: A National Need
2:30 - 3:15	General Discussion	
	Discussion Moderators	
	Coal Production	Dr. Charles J. Potter President Rochester-Pittsburgh Coal Company
	Coal Use	Mr. E. A. Pirsh, Manager New Products Engineering Babcock & Wilcox Company
	Environmental Protection	Mr. Leonard A. Green Immediate Past President Pa. Federation of Sportsman's Clubs
3:15 - 3:25	Summary	
	Mr. John Igoe Executive Vice President Bituminous Coal Research, Inc.	
3:25 - 3:30	Coal for the 70's: Pennsylvania Action	Dr. Thomas G Fox Governor's Science Advisor Commonwealth of Pennsylvania
3:30	Adjournment	

PENNSYLVANIA ENGINEERING TASK FORCE REPORTS

SUMMARY STATEMENTS

Summary Statement: Coal Mining Technology

The Task Force believes that it is possible to increase coal production in Pennsylvania from about 82.5 million tons per year in 1973 to about 100 million tons per year by 1980.

Accomplishing this goal will require: (1) an investment by the coal industry of millions of dollars to expand current facilities and to develop new facilities; (2) the recruitment and training of additional personnel to operate these expanded and new mines; (3) that some allowances be made for burning the Commonwealth's higher sulfur coals; and (4) that the Federal and State regulations concerning the environmental impacts of the mining industry and the health and safety of its workforce be administered fairly.

Summary Statement: Coal Preparation

The Commonwealth of Pennsylvania is unique among the coal-producing states in that it contains large reserves of coal which can be reduced in sulfur content by using coal preparation, a viable, modern technology with a history of proven accomplishment. Using available techniques and equipment, adequate tonnage of steam coal can be produced at a sulfur level that will meet the Commonwealth's SO_2 emission standards for existing stationary plants; however, it will be virtually impossible to produce adequate tonnage of 1 percent sulfur coal for new power stations as required by Federal regulations.

Further study and research and development is expected to demonstrate that the use of beneficiation techniques will be effective in helping Pennsylvania to achieve good environmental quality and to meet its energy needs during the remaining years of this decade.

Summary Statement: Combustion Technology

Combustion technology is relatively well established, with applicable equipment having been used during the last century. Attention is now being directed again to the use of stoker furnaces and various types of gasifiers, particularly for medium-size industrial applications which are permitted to burn coal with a fairly high sulfur content under current regulations. There are severe problems with equipment availability, however, since most of the facilities for manufacturing these types of equipment were scrapped many years ago. There is also some uncertainty as to how well various types of coal will perform in different devices, including improved designs now being developed. Thus, although the overall technology is highly developed, it should not be regarded as completely proven until demonstration projects are operated successfully for a period of several months.

Summary Statement: Tall Stacks and Supplementary Controls

The use of tall stacks and meteorologically-based emission limitation systems, together with other measures which car be taken, can help meet air quality and energy needs for Pennsylvania in the 1970's.

Summary Statement: Flue Gas Desulfurization

Reliability of flue gas desulfurization (FGD) systems for the electric utility industry has not been demonstrated sufficiently in the United States to justify installation of the equipment on all coal burning boilers in Pennsylvania. Further the task force believes that equipment and material supply problems will make it impossible to install many FGD systems within the next 3-5 years. Alternative means for meeting sulfur dioxide ambient air quality standards, such as tall stacks and intermittent control systems, should be used as an interim measure pending the successful completion of some of the demonstration programs now underway, especially those programs other than lime/limestone scrubbing.

COAL TASK FORCE REPORTS

SUMMARY STATEMENTS

Summary Statement: Finance

The Task Force emphasized the need for an assured future market for coal if private capital is to be attracted to mining. In addition, there must be a reasonable chance of a rewarding price extending into the future.

The large coal companies report that they are presently able to get the capital they need to increase production and they support many smaller companies who subcontract their production to the larger companies. In the future, however, capital needs will be enormous when large scale gasification and liquefaction plants are constructed, with one installation costing, in terms of present dollars, $400 to $500 million.

Concern was expressed that foreign buyers were purchasing large quantities of metallurgical coal which will inevitably cause shortages in the steel industry. Foreign capital, particularly Japanese, is searching for mines to be purchased which constituted, in some of the committee members' minds, a threat to domestic production.

The anthracite interests expressed the need for financial help for pumping water from mines. The Federal regulations are very restrictive and even present production is not secured by adequate backup pumping capacity.

Dr. Richard Gordon, Professor of Mineral Economics at Penn State University expressed reservations with the idea that financial incentives be made available to coal mining under present conditions. He suggested that the possibility for profit was adequate incentive to attract the needed capital for expansion of production.

State sources of capital to assist industrial development include funds from the Pennsylvania Industrial Development Authority (PIDA), the Site Development Act, and the Industrial and Commercial Development Authority (known as the Revenue Bond and Mortgage Program). The Department of Commerce plans to recommend new legislation amending the Revenue Bond and Mortgage Program to make tax free financing more readily available to energy producers.

Summary Statement: Manpower Needs

Currently there is practically no demand for miners in anthracite; bituminous is readily filling its needs.

Productivity per man day in bituminous is more than twice that in anthracite, adding substantially to the cost of mining anthracite. This must somehow be increased to bring anthracite into a competitive position.

Very few workers, trained or untrained, would be available for the anthracite industry

Trained workers are far superior to untrained workers. Training should be directed toward a special occupation in lieu of generalized training.

Training under Section 2508.3 of the School Code is available for training the underemployed, the unemployed, part time and for upgrading purposes.

Simulated mines (above ground) have been established for training purposes in the bituminous area.

The facilities and services of the 122 local offices of the Bureau of Employment Security are immediately available for solving manpower problems and establishing corrective actions.

Bureau of Employment Security will conduct an informal sounding of availability from its regular intake.

Governor Shapp petitioned Secretary of Labor, P. J. Brennan, requesting immediate consideration to award substantial amounts of training money ($7 million) for the establishment of training in the mining industries of Pennsylvania.

Summary Statement: Transportation

Transportation for Coal: Public representatives explained how poor and derailment-prone rail service is. Trucking coal is economically prohibitive over longer distances and is ecologically unacceptable. A better supply of cars operating on much shorter turn arounds over safe upgraded track is essential. Legislation is pending in Congress to provide large scale rail rolling stock loan authority. This, plus a sustained market, is necessary to solve this problem.

Penn Central reported commitments for upgrading 4,500 hopper or coal carrying cars during the current budget year. Attrition will offset much of this effort, however. Because of Penn Central's posture in bankruptcy court, they cannot make commitments for additional new cars. Long term mine contracts of consumption contracts are necessary to permit financing of additional cars. Some coal consumers buy their own cars to assure control over required supply.

Reading Company, with a similar problem could throw off bankruptcy and reorganize if sustained coal movement could be reestablished. The mine operators cannot open efficient new mines without long term market commitments.

Coal for Transportation: Since transportation consumes nearly a fourth of the nation's energy, which is heavily oil based, it would be a tremendous lift to the national economy to use more coal for transportation. Oil is being used in spite of price and shortage to meet clean air requirements.

The Federal Railroad Administration has reported that 120 million gross tons move across Pennsylvania by rail between Harrisburg and Pittsburgh each year. This is twice the tonnage of any other rail segment reported. Railroad and industry committee members agreet that electrification of this railroad would have a tremendously beneficial impact on the Commonwealth, its industry, its consumers, and its railroads. The U. S. Secretary of Transportation and several western railroads are seriously considering railroad electrification. Electrification from Harrisburg to Conway (west of Pittsburgh) would save an estimated 50 million gallons of fuel oil per year if coal generated electricity were substituted. This is a $11 million annual coal market for Pennsylvania producers and their employees. It would have many other consumer benefits for the general public.

The committee determined that there are nearly twelve billion tons of less than 1% low sulphur coal in the anthracite region, a significant portion of which could be used to generate electricity to power transportation by rial.

Bituminous coal of good quality from central and southwestern Pennsylvania can also be used with desulphuring processes. There is still some technological difficulty with economical application of this process, however. Research should perfect it as rapidly as possible.

The large initial cost of such a change in railroad fuel can be recovered over a reasonable amortization period from savings if there are no excessive penalties on the investment. The social benefits are all plus. It was agreed that railroads and power companies should seek a solution to this problem for their common good.

Summary Statement: Coal Related Environmental Problems

The Task Force agreed to concentrate its efforts toward utilization of coal while achieving environmental protection. Specifically, we agreed to emphasize the following points:

Better financial incentives for the coal producers and coal users, such as tax-free bonds and changes in PUC rates to compensate for installation of pollution control facilities at power plants, and other pollution prevention measures.

Additional tax incentive programs for companies installing pollution control equipment.

Acceleration of review and issuance of coal-related permits by the Department of Environmental Resources (DER).

Review of Keystone Bituminous Coal Association's letter of January 4, 1974, which included environmental problems confronting the coal and coal-related industries.

Summary Statement: Research & Development

For the last several years, the funding for State coal reserve projects has been completely inadequate and many potential projects have languished. There are now enormous funds available at the Federal level ($500 to $600 million for coal research alone) which can be tied with State funds on a high leverage basis. Pennsylvania has outstanding competence for coal research. The State's universities, research organizations, and industries have had rich experience which should be utilized to the maximum, now, for the benefit of the State.

There are, a myriad of research programs where State supported research can be tremendously effective in developing leadership for Pennsylvania, its industries and citizens. There was a firm belief that we must choose a few areas for action. Programs should be limited to where there is good R & D capability, funded adequately, and of definitive scope and rate. We can get meaningful activities funded now in substantial amounts, but in order to do it, seed money must be appropriated by the Legislature.

RECOMMENDATIONS

The recommendations from the nine task forces to a degree overlap. In order to gain some perspective of their total thrust, the recommendations are collected here under a tentative and somewhat arbitrary classification, as follows:

Major Policy and Financing

Action Priorities

Manpower

Environment

Research and Development

The task force report from which the recommendations are taken is identified under these major headings (Note: Recommendations on Transportation Policy are included under the first category).

RECOMMENDATIONS

MAJOR POLICY AND FINANCING

Mining Technology

Take whatever actions deemed necessary to promote the execution of long-term contracts for Pennsylvania's coals to guarantee a reasonable return on capital invested in expanded and new coal production facilities.

Coal Preparation

The Commonwealth of Pennsylvania should immediately initiate a program to promote the widespread application of physical desulfurization to amenable coals by the coal mining industry, using existing coal-cleaning equipment and techniques.

Manpower

Planning must be long range, 15 to 20 years, with assurances of sustained product need. Tapping the 12 billion ton anthracite reserve will require extensive research, the expenditure of tremendous sums of money and a greatly improved image of the industry.

Proposed railroad abandonments, if accomplished, would seriously restrict the rejuvenation of mining. Protest will be lodged at ICC hearings in March at Pittsburgh, Philadelphia and Aveca.

Transportation

Added rail cars must be financed.

Rail track rehabilitation must be financed.

Rail lines into coal deposits must be retained as suggested by PL 93-236.

Electrification for specific rail lines should be financed.

Coal Related Environmental Problems

It is essential that the electric power industry be allowed to automatically pass through the cost of environmental protection equipment in the same manner that increases in fuel prices are now passed through. Specific draft language is being developed.

Tax incentives to encourage installation of environmental protection facilities to meet Federal and State laws should be provided. We are developing specific draft language. The present existence of tax incentives on the State income and sales tax for pollution control equipment will be more widely disseminated to those operators who apparently are not taking advantage of these incentives.

The State revenue bond program presently operated by the Department of Commerce should be expanded to permit the coal industry to participate. It is recommended that you request the Department of Commerce to explore this possibility and draft any appropriate legislation.

A system of parity price support should be considered for coal mining in a manner similar to the nation's agricultural programs. This would add much-needed stability to the industry, particularly the small operators who are adversely impacted by safety and environmental constraints. If a satisfactory plan is developed, appropriate State or Federal legislation should then be drafted to implement these concepts.

Stack Gas Scrubbing

As an incentive to install FGD systems, the State public utility commission should be urged to treat increased costs from FGD control in the same manner as increased fuel costs are treated.

Coal Task Force on Finance and Research and Development

The Department of Commerce plans to recommend to the General Assembly

Revenue Bond and Mortgage Amendments

Specifically name energy producing enterprises as authorized projects.

Remove the requirement that an energy producing enterprise create substantial employment as a result of the loan.

Allow energy producing equipment and machinery to be financed separately; that is, remove the prohibition that required new construction to accompany any equipment financing.

Authorize any municipality to make grants or loans to industrial development authorities to assist them in financing projects.

The effect of these amendments should be to make tax free financing more readily available to meet the needs of energy producers.

ACTION PRIORITIES

Mining

Promote the growth of the Commonwealth's mining equipment manufacturing capability.

To the extent possible, assure the availability of the fuels, lubricants, explosives, and other supplies and materials necessary for the production of coal.

Review current rules and regulations designed to minimize the impacts of coal mining on the environment and to safeguard the health and safety of coal mine workers to determine their adequacy. As indicated, these regulations should be updated and, to the extent possible, revised to conform to those of adjacent states and the federal government.

Coal Preparation

A program should be initiated to compile existing information so as to define the location and characteristics of both the coal being mined and the coal reserves and their potential for upgrading by coal preparation and location of the power plants utilizing these coals, and the sulfur limits under which they must operate.

A detailed economic assessment of the benefits that a wide application of presently available coal beneficiation techniques to the coal able to be supplied for use in steam generators should be made. This assessment must delineate and correlate energy losses, coal quality improvement, costs, and environmental impacts.

Transportation

Low sulphur Pennsylvania coal must be returned to power generation.

Long term markets for such coal must be assured.

Combustion Technology

Encourage coal producers or others to market "graded" coal (uniform in size, quality, etc.) for small and medium-size users.

Provide assistance to users in procuring coal burning equipment, identify supply "bottlenecks".

Encourage and support investigation of the performance of gasifiers ("demonstration" projects), both the types formerly used and new types (e.g., fluidized bed).

Stack Gas Scrubbing

The movement of supplies and materials should be coordinated and expedited to obtain maximum efficiency in installing FGD and other control measures.

Coal Related Environmental Problems

Although a very small fraction of the total lime used in Pennsylvania is utilized for acid mine drainage treatment, this fraction is extremely important since it provides protection to hundreds of miles of Pennsylvania's streams. Whenever lime manufacturing or delivery is curtailed for any reason, lime for mine drainage treatment should receive high priority in any allocation scheme.

There continues to exist a roof bolt shortage problem in Pennsylvania as well as other mining states. The Administration should continue to emphasize to the bolt manufacturing industry the importance of roof bolt production; and in a similar manner to number 10 above, give high priority to assure roof bolt delivery to Pennsylvania deep mines.

Although some progress has been made by the Department of Environmental Resources in expediting the processing of permits involving coal operations, this has temporarily delayed permits involving other industries and segments of the environmental protection program. Even at that, the permit-processing time is still too long to satisfactorily meet the growing demand for such permits by the coal industry. DER should be allocated additional funds and positions to obtain the necessary staff to properly carry out this important function.

It has been suggested that DER investigate the possibility of introducing an "interim" permit program for anthracite strip mines which would delete or delay submission of certain technical data now required. The Department will explore the technical, legal, and administrative ramifications of such a program.

MANPOWER

Coal Task Force on Manpower

A concensus of opinion was that vo-tech schools should establish courses for the mining industry. This would serve the added purpose of improving the damaged image of mining as an occupation and way of life.

Distinction must be made between inside and strip mining as well as between anthracite and bituminous.

Present training plans contain far too many restrictions. Training under the new Comprehensive Employment and Training Act (CETA) should be tailored to meet the industry's requirements.

Orientation or pre-employment training is desirable but should be supplemented by on-the-job training for specific occupations.

Mining

Aid the industry in the training of all levels of personnel needed urgently by the coal industry to include miners, mechanics, electricians, supervisory personnel and engineers.

Combustion Technology

Assist in the establishment of a program for training operating personnel.

Stack Gas Scrubbing

Educational programs should be developed to train personnel to design and operate FGD equipment.

Coal Task Force on Finance and Research and Development

State support of educational facilities for coal mining education.

State support of scholarships in coal mining engineering. There are inadequate numbers of engineers being graduated today.

ENVIRONMENT

Coal Related Environmental Problems

If an energy bill is passed by Congress which allows more time for compliance with primary air pollution standards, the Environmental Quality Board and the Department should allow variances pursuant to the act which would provide reasonable time for compliance but which would be tied to specific schedules to assure progress towards compliance.

The coal industry and the Department should jointly investigate the feasibility of developing a program for stockpiling low sulfur coal for the utilization at power plants and other coal burning facilities when adverse climatological conditions, such as air inversions, necessitate stack emissions of very low sulfur content.

In regard to the water quality standards affecting mines and coal processing plants, the Department is in the process of implementing a policy as follows:

Use an "average value" approach in setting treatment plant effluent requirements pertaining to iron. A monthly average value effluent limitation will be used rather than daily values used with other wastes. Also, a value of two times the monthly average is permissible at any one time.

The point at which the water quality criteria is to be measured is a water body with true stream characteristics determined by field checks. We will not apply water quality criteria to ditches or swales.

In recognition of possible upsets to treatment facilities during cold weather, the best practicable treatment limits can be used (4 mg/1 average iron, maximum value 7 mg/1) except for discharges to "cold water" streams and "Conservation areas".

The preliminary EPA suspended solids proposed effluent guidelines of 30 mg/1 average and 90 mg/1 maximum were distributed by EPA for comments and are in no way final. We understand they were prepared without a study or recommendations of outside consultants as is the usual practice. We are now meeting with EPA staff and reviewing the rationale for these proposed guidelines.

The U. S. Bureau of Mines has recently published proposed regulations concerning the disposal of coal refuse. In June, 1973, the Department's new coal refuse regulations went into effect and are presently being implemented. The Department should review the proposed Federal regulations and, if necessary, meet with the Bureau of Mines' personnel so that uniform regulations can be developed. Particular emphasis should be placed on reviewing the coal refuse pile slope limitations which differ in the two sets of criteria.

Mining

Permit the burning of coals containing more than about 1.2 percent sulfur so long as prevailing ambient air quality standards are not compromised.

Coal Preparation

There is a need to study such ancilliary operations to effective fine cleaning as dewatering and moisture reduction, agglomeration and clarification of "black" water.

Tall Stack & Supplementary Controls

Any use of the tall stack/supplementary controls technology ought not be at the expense of discouraging other techniques and technologies, notably FGD systems and coal preparation techniques.

The tall stack/supplementary controls technology should be viewed for the present as an interim measure which will allow quick attainment of SO_2 AAQS, until definitive evidence on secondary environmental impacts is obtained.

Stack Gas Scrubbing

Steps should be taken to allow the use of alternative control measures for meeting the primary air quality standards. The use of tall stacks, intermittent control systems, and coal cleaning have shown their ability to be an effective means for controlling sulfur oxide emissions.

Formal procedures should be developed to permit continued power generation during ventable malfunction of the FGD system.

A sulfur oxide control committee chould be established to follow the work of others and keep the Pennsylvania utilities informed of advancement in FGD technology.

Relaxation of compliance schedules should be made to allow time for further improvement in FGD system reliability.

RESEARCH AND DEVELOPMENT

Coal Task Force on Finance, Research and Development

Five priority research areas were listed

Coal gasification
Coal liquefaction
New anthracite mining technologies
Coal characterizations
Coal preparation (desulfurization and cleaning)

In all these areas, particularly low BTU gasification, the State presently has programs under way, all of which need additional funding.

In addition to the five subjects listed above, many others were identified as worthy of consideration.

Mining equipment efficiency research.
Coal energy utilization efficiency research.
Current state survey on coal reserves.
Ongoing research on large scale mining and surface reclamation. Assure present state preeminence.
Trace elements effects on coal combustion.
Programs to facilitate study of foreign research. Perhaps translation and travel/study grants should be awarded.
Impartial studies on effect of sulfur in atmosphere. There was considerable belief that prior studies were scientifically suspect.

Mining

Encourage the development of new and improved mining methods and equipments by institutions of higher learning, mining machinery manufacturers and commercial coal companies and by expediting the approval of new and experimental equipments.

Coal Preparation

A research and development program directed toward the proper disposal and/or possible use of the waste products from coal preparation plants, and the mines themselves (which always provide some degree of preparation), should be initiated. This effort should be strongly supported.

Research and development of improved beneficiation techniques should be supported on a long-term, low-priority basis.

Combustion

Encourage and support further research into the operational mechanisms of gasification as a basis for rapid further development in size, efficiency and design.

Coal Related Environmental Problems

The proposed Federal budget for fiscal year 1975 includes over $178 million for energy-related research and development pertaining to environmental control. Eighty-two million dollars of this amount includes research on "near term SO_x" projects. Some of Pennsylvania's power companies are investing large sums for installation of sulfur removal equipment although there is a lack of confidence by industry in the reliability of the facilities to operate full time. Duquesne Light Company, for example, now has a $50 million investment in two of its plants. Since sulfur removal technology is still in its early stages, we believe it is appropriate for a portion of the $82 million earmarked for research and development in research to further this technology for the benefit of the nation's electric generating industry. The industry, State and Federal representatives should prepare a specific proposal for such research and development work and meet with Federal officials to promote this important research--hopefully in Pennsylvania.

Tall Stacks & Supplementary Controls

Active research and investigation into environmental impacts associated with tall stacks should be supported (for example, investigations concerning morbidity and mortality effects associated with specific sulfate concentrations). This research should be supplemented by increased ambient monitoring of sulfate levels, heavy metal levels, etc.

Current successful applications of the tall stack/supplementary controls technology are limited to rural locations, where unique source-receptor relationships can be assumed. If the technique is to be implemented in multiple-source regions, research must be completed. Such research would not only insure the reliability of supplementary controls but also safeguard legal enforceability of these intermittent emission limitations.

Gas Stack Scrubbing

Research and development work is required to determine the effectiveness of sludge disposal systems. An air pollution problem should not be traded for a water pollution problem.

Four Coal Task Force Reports

Task Force	Chairman
Finance, Research and Development	Hon. George E. Bartol, III Pa. Department of Commerce
Manpower	Hon. Paul J. Smith Secretary of Labor and Industry
Transportation	Hon. Maurice K. Goddard Secretary of Environmental Resources
Coal Related Environmental Problems	Hon. Jacob G. Kassab Secretary of Transportation

FINANCE, RESEARCH AND DEVELOPMENT

TASK FORCE REPORT

Finance

The Task Force emphasized the basic need for an assured future market for coal if private capital is to be attracted to mining. In addition, there must be a reasonable chance of a rewarding price extending into the future.

The large coal companies report that they are presently able to get the capital they need to increase production. They report that, in addition, they support many smaller companies who subcontract their production to the larger companies. In the future, however, their capital needs will be enormous when large-scale coal gasification and liquefaction plants are constructed, with one installation costing, in terms of present dollars, $400 to $500 million.

Concern was expressed that foreign buyers were purchasing large quantities of metallurgical coal which will inevitably cause shortages in the domestic steel industry. It was also pointed out that foreign capital, particularly Japanese, was searching for mines to be purchased. This constituted, in some of the committee members' minds, a threat to domestic supply.

The anthracite interests expressed the need for financial help for pumping water for mines. The Federal regulations are very restrictive for financial aid and even present production is not secured by adequate backup pumping capacity.

Dr. Richard Gordon, Professor of Mineral Economics at Penn State University, expressed reservations regarding the idea that financial incentives be made available to coal mining under present conditions. He made the point that the possibility for profit was adequate incentive to attract the needed capital for expansion of production.

Coal Research & Development

The opportunities for expanded coal research in the State took the majority of the Task Force's time. While much is now going on in the State, there are many projects that could and should be supported. For the last several years, the funding for State projects has been completely inadequate and many potentially worthwhile projects have languished. There are now or soon will be enormous funds available at the Federal level ($500 to $600 million for coal research alone) which can be tied in with State funds on a high leverage basis. Pennsylvania has outstanding competence for coal research. The State's universities, research organizations, and industries have had rich experience which should be utilized to the maximu, now, for the benefit of the State and the nation.

Five priority research areas were listed by Dr. William Spackman, head of the Coal Research Section, Penn State University. They were:

1) Coal gasification systems
2) Coal liquefaction systems
3) New anthracite mining technologies
4) Coal characterization
5) Coal preparation (desulfurization and cleaning)

In all these areas, particularly low BTU gasification, the State presently has programs under way, all of which need additional funding.

In addition to the five subjects listed above, many others were identified as worthy of consideration. These are listed below without priority ranking.

1) Mining equipment research.
2) Coal energy utilization efficiency research.
3) Current State geological survey on coal reserves and their availability.
4) Ongoing research on large scale mining and surface reclamation. Assure continuation of present State preeminence.
5) Trace element effects on coal combustion.
6) Programs to facilitate study of foreign research. Perhaps translation and travel/study grants should be awarded.
7) State support of scholarships in coal mining engineering. There are inadequate numbers of mining engineers being graduated today.

8) State support of educational facilities for coal mining education other than mining engineers.
9) Impartial studies of effect of sulfur in the atmosphere. There was a belief that prior studies were scientifically suspect.

There are, as one can see, a large number of research programs where State supported research can be tremendously effective in developing a leadership position for Pennsylvania, its industries and citizens. The difficulty of choosing the most important projects will not be easy. Nevertheless, there was a firm belief that choose we must and that only a few areas be defined for action. Pennsylvania's programs should be limited to technical areas where there is good R & D capability, they should be funded adequately, and be definitive in scope. We should get meaningful research activities funded now and in substantial amounts, but in order to do it properly, seed money must be appropriated by the Legislature.

V

FORM OA-501

COMMONWEALTH OF PENNSYLVANIA
HARRISBURG

March 7, 1974

SUBJECT: Subcommittee on Manpower
Governor's Committee on the Energy Crisis

TO: The Honorable Ernest P. Kline
Lieutenant Governor of Pennsylvania

FROM: Paul J. Smith
Secretary of Labor and Industry

The Subcommittee on Manpower has held two meetings thus far on January 22, 1974 and February 5, 1974. Following were in attendance:

Francis Bonner	Stephen McCann
Grant R. Brown	James McCoy
William E. Byers	Frank Mohney
Paul Cadden	Francis K. Monahan
John M. Clark	Lucy Norton
John F. Cooney	Charles E. Odell
Charles E. Currier	Angelo J. Olivetti
William Darkes	Dr. Wayne Reavis
Martin Dulansey	L. F. Richter
Edward J. Finegan	Armand Santariello
Edward D. French	William Savitsky
Arnold Harvey	William Schaffstall
James H. Hurley	John V. Scalise
Robert Johnson	Albert Smigel
J. Earl Lamont	Paul J. Smith
Robert Laughlin	Walter Vicinelly
Clyde Machamer	Edward Wagner
Martin Margolis	Albert Williams
Eli Matovich	James Wittle

The following is a summary of what transpired at these meetings.

The January 22, 1974 meeting - Facts Developed:

"Many thousands of workers are immediately available for mining work in the bituminous areas" according to Mr. Stephen McCann.

MAR 0 4 1974

Very few workers, trained or untrained, would be available for the anthracite industry (Mr. [illegible] Snyder and Savitsky).

Bureau of Employment Security will conduct an informal sounding of availability from its regular intake.

Trained workers are far superior to untrained workers. Training should be directed toward a special occupation in lieu of generalized training.

Orientation or pre-employment training is desirable but should be supplemented by on-the-job training for specific occupations.

A commitment should be obtained from each potential trainee prior to entering training indicating willingness to work in the mining industry.

Distinction must be made between inside and strip mining as well as between anthracite and bituminous.

Simulated mines (above ground) have been established for training purposes in the bituminous area.

Governor Shapp petitioned Secretary of Labor P. J Brennan, requesting immediate consideration to award substantial amounts of training money ($7 million) for the establishment of training in the mining industries of Pennsylvania.

In the bituminous industry, new hiring must be done in the labor classification; the union bidding procedure holds for the higher classified positions.

A concensus of opinion was that vo-tech schools should establish courses for the mining industry. This would serve the added purpose of improving the damaged image of mining as an occupation and way of life.

Planning must be long range, 15 to 20 years, with assurances of sustained product need. Tapping the 12 billion ton anthracite reserve will require extensive research, the expenditure of tremendous sums of money and a greatly improved image of the industry.

The facilities and services of the 122 local offices of the Bureau of Employment Security are immediately available for solving manpower problems and establishing corrective actions.

Productivity per man day in bituminous is more than twice that in anthracite, adding substantially to the cost of mining anthracite. This must somehow be increased to bring anthracite into a competitive position.

Proposed railroad abandonments, if accomplished, would seriously restrict the rejuvenation of mining. Protest will be lodged at ICC Hearings in March at Pittsburgh, Philadelphia and Avoca.

Present training plans contain far too many restrictions. Training under the new Comprehensive Employment and Training Act (CETA) should be tailored to meet the industry's requirements.

Training under Section 2503.3 of the School Code is available for training the underemployed, the unemployed, part time and for upgrading purposes.

Currently there is practically no demand for miners in anthracite; bituminous is readily filling its needs.

JFCooney:mm
cc: Mr. Clark
Mr. Finegan
Mr. Monahan
Secretary Smith (2)
Mr. Hamrai - Governor's Office
Mr. Knopf - Lt. Governor's Office

February 22, 1974

SUBJECT: Task Force on Coal Related Environmental Problems

TO. Lt. Governor Ernest P. Kline

FROM. Maurice K. Goddard
Secretary of Environmental Resources

The Task Force on Coal Related Environmental Problems met in my office on February 6, 1974. The following persons were in attendance at this meeting:

Mr. H. B. Brown, President
Keystone Bituminous Coal Association

Mr. Emmett Lang, President
Central Pa. Coal Producers Association

Mr. H. E. Steinman, Chief Mining Eng.
Jones & Laughlin Steel Corporation

Mr. William Kegel
Jones & Laughlin Steel Corporation

Mr. James Schaeffer
Rochester & Pittsburgh Coal Co.

Mr. Steven Pernick
Pa. Electric Association & Duquesne Light Co.

Mr. James Tedesco, President
Lehigh Valley Coal Company

Mr. Arnold Harvey, Liaison Officer
U. S. Bureau of Mines

Mr. Clyde L. Machamer, President
Independent Miners and Associates

Mr. Henry Bowman
Independent Miners and Associates

Deputy Secretary Abe L. Yablon
Department of Revenue

Department of Environmental Resources
Secretary Maurice K. Goddard
Deputy Secretary Wesley E. Gilbertson
Associate Deputy Secretary Walter N. Heine ✓

The Task Force agreed to concentrate its efforts toward utilization of coal while achieving environmental protection. Specifically, we agreed to emphasize the following points:

1. Better financial incentives for the coal producers and coal users, such as tax-free bonds and changes in PUC rates to compensate for installation of pollution control facilities at power plants, and other pollution prevention measures.

2. Additional tax incentive programs for companies installing pollution control equipment.

3. Acceleration of review and issuance of coal-related permits by the Department of Environmental Resources (DER).

4. Review of Keystone Bituminous Coal Association's letter to you of January 4, 1974, which included environmental problems confronting the coal and coal-related industries.

During the three-hour meeting, the Task Force agreed to set forth the following recommendations to you:

1. It is essential that the electric power industry be allowed to automatically pass through the cost of environmental protection equipment in the same manner that increases in fuel prices are now passed through. Specific draft language is being developed.

2. Tax incentives to encourage installation of environmental protection facilities to meet Federal and State laws should be provided. We are developing specific draft language. The present existence of tax incentives on the State income and sales tax for pollution control equipment will be more widely disseminated to those operators who apparently are not taking advantage of these incentives.

3. The State revenue bond program presently operated by the Department of Commerce should be expanded to permit the coal industry to participate. It is recommended that you request the Department of Commerce to explore this possibility and draft any appropriate legislation.

4. If an energy bill is passed by Congress which allows more time for compliance with primary air pollution standards, the

Environmental Quality Board and the Department should allow variances pursuant to the act which would provide reasonable time for compliance but which would be tied to specific schedules to assure progress towards compliance.

5. The proposed Federal budget for fiscal year 1975 includes over $178 million for energy-related research and development pertaining to environmental control. Eighty-two million dollars of this amount includes research on "near term SO_x" projects. Some of Pennsylvania's power companies are investing large sums for installation of sulfur removal equipment although there is a lack of confidence by industry in the reliability of the facilities to operate full time. Duquesne Light Company, for example, now has a $50 million investment in two of its plants. Since sulfur removal technology is still in its early stages, we believe it is appropriate for a portion of the $82 million earmarked for research and development work be assigned to companies agreeable to participate in research to further this technology for the benefit of the nation's electric generating industry. The industry, State and Federal representatives should prepare a specific proposal for such research and development work and meet with Federal officials to promote this important research--hopefully in Pennsylvania.

6. The coal industry and the Department should jointly investigate the feasibility of developing a program for stockpiling low sulfur coal for the utilization at power plants and other coal burning facilities when adverse climatological conditions, such as air inversions, necessitate stack emissions of very low sulfur content.

7. A system of parity price support should be considered for coal mining in a manner similar to the nation's agricultural programs. This would add much-needed stability to the industry, particularly the small operators who are adversely impacted by safety and environmental constraints. If a satisfactory plan is developed, appropriate State or Federal legislation should then be drafted to implement these concepts.

8. In regard to the water quality standards affecting mines and coal processing plants, the Department is in the process of implementing a policy as follows:

   a. Use an "average value" approach in setting treatment plant effluent requirements pertaining to iron. A <u>monthly</u> average value effluent limitation will be

used rather than daily values used with other wastes. Also, a value of two times the monthly average is permissible at any one time.

b. The point at which the water quality criteria is to be measured is a water body with true stream characteristics determined by field checks. We will not apply water quality criteria to ditches or swales.

c. In recognition of possible upsets to treatment facilities during cold weather, the best practicable treatment limits can be used (4 mg/l average iron, maximum value 7 mg/l) except for discharges to "cold water" streams and "Conservation areas".

d. The preliminary EPA suspended solids proposed effluent guidelines of 30 mg/l average and 90 mg/l maximum were distributed by EPA for comments and are in no way final. We understand they were prepared without a study or recommendations of outside consultants as is the usual practice. We are now meeting with EPA staff and reviewing the rationale for these proposed guidelines.

9. The U. S. Bureau of Mines has recently published proposed regulations concerning the disposal of coal refuse. In June, 1973, the Department's new coal refuse regulations went into effect and are presently being implemented. The Department should review the proposed Federal regulations and, if necessary, meet with the Bureau of Mines' personnel so that uniform regulations can be developed. Particular emphasis should be placed on reviewing the coal refuse pile slope limitations which differ in the two sets of criteria.

10. Although a very small fraction of the total lime used in Pennsylvania is utilized for acid mine drainage treatment, this fraction is extremely important since it provides protection to hundreds of miles of Pennsylvania's streams. Whenever lime manufacturing or delivery is curtailed for any reason, lime for mine drainage treatment should receive high priority in any allocation scheme.

11. There continues to exist a roof bolt shortage problem in Pennsylvania as well as other mining states. The Administration should continue to emphasize to the bolt manufacturing industry the importance of roof bolt production; and in a similar manner to number 10 above, give high priority to assure roof bolt delivery to Pennsylvania deep mines.

12. Although some progress has been made by the Department of Environmental Resources in expediting the processing of permits involving coal operations, this has temporarily delayed permits involving other industries and sec[illegible] of

the environmental protection program. Even at that, the permit-processing time is still too long to satisfactorily meet the growing demand for such permits by the coal industry. DER should be allocated additional funds and positions to obtain the necessary staff to properly carry out this important function.

13. It has been suggested that DER investigate the possibility of introducing an "interim" permit program for anthracite strip mines which would delete or delay submission of certain technical data now required. The Department will explore the technical, legal, and administrative ramifications of such a program.

cc: Members of the Task Force
Francis Bonner (Governor's Office)

Department of Transportation
February 25, 1974

COAL TASK FORCE

The Honorable Ernest P. Kline
Lieutenant Governor

E. L. Tennyson for The Honorable Jacob G. Kassab on Transportation
Deputy Secretary for Local and Area Transportation

At your direction, the Transportation Section of your Coal Task Force met on February 14 to review this aspect of the energy crisis.

Present were:

Walter R. Chapel, Executive Director, RR. Task Force for Northeastern Penna. - (EDCNEP)
Robert D. Laughlin, Executive Dir., Penna. Science and Engineering Foundation
James Tedesco, President, Pagnoth Coal Co.
Frank Montgomery, Vice Pres. & Managing Director, Pennsylvania Electric Association
Walter Lloyd, Vice Pres., Coal/Hauling Operator, Penn Central
Mr. Michael Petresky - Public Utility Commission
R. A. Peteritas, Public Utility Commission
Mr. William B. Harral, Governor's Office
Tom Sharpe, PP&L Co., R.R. Task Force for NE Pennsylvania
Bernie Blier, Railroad Task Force for NE Pennsylvania
Robert E. Flynn, Short Line Railroad Association
A. W. Nemenz, A.V.P., Reading Co.
Dwight L. Koerber, Coal Traffic Bureau, Pittsburgh, Pa.
E. L. Tennyson, Deputy Secretary for Local & Area Trans.

The delegates were diligent in their interest and attention to this most pressing problem. Large areas of consensus appeared evident and provided an excellent working base for your Coal Task Force.

TRANSPORTATION FOR COAL

Penn Central reported that they have commitments for upgrading 4,500 hopper or coal carrying cars during the current budget year. Attrition will offset much of this effort, however. Because of Penn Central's posture in bankruptcy court, they cannot make commitments for additional new cars. Long term mine contracts or consumption contracts are necessary to permit financing of additional cars. Some coal consumers buy their own cars to assure control over required supply. PP&L and Detroit Edison are among this group.

Reading Company, on a smaller scale, reported a similar problem Reading could throw off bankruptcy and reorganize if sustained coal movement could be reestablished. The mine operators agreed with the railroads on this. They will not open efficient new mines without long term market commitments.

Public representatives explained how poor derailment prone rail service is. Trucking coal is economically prohibitive over longer distances and is ecologically unacceptable over any distance. A better supply of cars operating on much shorter turn arounds over safe upgraded track is essential. Legislation is pending in Congress to provide large scale rail rolling stock loan authority. This, plus a sustained market, is necessary to solve this problem.

COAL FOR TRANSPORTATION

Since transportation consumes nearly a fourth of the nation's energy, which is heavily oil based, it would be a tremendous lift to the national economy to introduce more coal into the provision of energy for transportation. Coal is much more available and much less costly than oil which is being used in spite of price and shortage to meet clean air requirements.

Our committee determined that there are nearly a dozen billion tons of less than 1% low sulphur coal in the anthracite region, a significant portion of which could be used to generate electricity to power transportation by rail, as well as provide general purpose electricity. There are many air quality regions in the State where low sulphur coal can be legally burned, with large savings to all concerned.

Bituminous coal of good quality from central and southwestern Pennsylvania can also be used with desulphuring processes. There is still some technological difficulties with economical application of this process, however. Research should perfect it as rapidly as possible.

The Federal Railroad Administration has reported that 120 million gross tons move across Pennsylvania by rail between Harrisburg and Pittsburgh each year. This is twice the tonnage of any other rail segment reported. Railroad and industry committee members agreed that electrification of this railroad would have a tremendously beneficial impact on the Commonwealth, its industry, its consumers, and its railroads. The U. S. Secretary of Transportation and several western railroads are seriously considering railroad electrification. Electrification from Harrisburg to Conway (west of Pittsburgh) would save an estimated 50 million gallons of fuel oil per year if coal generated electricity were substituted. This is a $11 million annual coal market for Pennsylvania producers and their em-

ployees. It would have many other consumer benefits for the general public.

The large initial cost of such a change in railroad fuel can be recovered over a reasonable amortization period from savings if there are no excessive penalties on the investment. The social benefits are all plus. It was agreed that railroads and power companies should seek a solution to this problem for their common good.

Because of the long range nature of the energy situation, an immediate start on the reintroduction of coal within legal and economic limits is essential. Temporarily, should electric generating capacity lag the provision of electric transportation, retired diesel locomotives can be operated stationary on a continuous peak basis to generate electricity since only 50% as much central station capacity is required to serve 100% of rolling stock demand, averaged out by coasting and non-moving time of trains. At off hours, trains can operate on existing installed capacity.

OTHER CONSIDERATIONS

The committee discussed peripheral aspects of the coal transportation problem, but no significant recommendations developed that were not thoroughly discussed with specific reference to the preceding deliberations.

SUMMARY

1. Low sulphur Pennsylvania coal must be returned to power generation.

2. Long term markets for such coal must be assured.

3. Following 1 and 2, added rail cars must be financed.

4. Rail track rehabilitation must be financed.

5. Rail lines into coal deposits must be retained as suggested by PL 93-236.

6. Electrification for specific rail lines should be financed.

600/ELT/mva

April 5, 1974

COAL FOR THE 70's

Selected Background Documents

News Release - Roger C. B. Morton, Secretary of the Interior, March 29, 1974 (Courtesy of Dr. Thomas V. Falkie, Director, U. S. Bureau of Mines).

Bureau of Mines Narrative on Coal's Problems and Solutions (Courtesy of Dr. Thomas V. Falkie, Director, U. S. Bureau of Mines).

Excerpts from the Cornell Workshops on the National Energy Research and Development Program.

DEPARTMENT of the INTERIOR

news release

For Release On Delivery 8:00 P.M., EDT, March 29, 1974

REMARKS OF THE HONORABLE ROGERS C. B. MORTON, SECRETARY OF THE INTERIOR, WEST VIRGINIA UNIVERSITY SCHOOL OF MINES, MORGANTOWN, WEST VIRGINIA, MARCH 29, 1974

If I were asked to name the energy source that has the greatest potential over the next twenty-five years, I would automatically say "coal." And if I were asked to say which energy source has the greatest problems ahead of it, I would have to give the same answer.

This is a pretty fair arrangement. The potential is a given, in any situation, and you have to work with it as it is. We can do something about the problems, and we will. Tonight I would like to talk about both the potential and the problems of coal, and what we see to be some approaches to the problems.

One of the ironies of our energy problem is that we use so little of our most abundant energy source. Our current economically recoverable reserves of coal come to a little under 200 billion tons which is enough to last us for hundreds of years. This is about nine-tenths of our total fossil fuel reserve, yet coal supplied less than 18 percent of our energy needs last year. Our need, and our intention, is to increase coal's contribution to the fuel economy dramatically. We would like to see coal take over as much of the stationary heat and power load as is practicable, so that oil and gas can be conserved for use as specialty fuels and chemical building blocks.

The enlarged role we envision for coal will require greatly increased coal production--perhaps as much as 2 billion tons annually by 1985. This as you will recognize, is better than three times the 600 million tons that we produced in 1973.

This is a tall order, and two things will have to take place. First, we will need to make a market for this much coal, which is mainly a function of its environmental acceptability. Second, we will have to find ways of producing enough coal at acceptable social and economic cost, to satisfy the market we have created. The requirement here is for a coal industry capable of delivering the coal that will be needed.

Most of the verbiage and money coming out of government recently has been directed to the downstream end of the chain of coal problems; that is, how to clean up coal, either by changing it to low-sulfur fuels, or by removing the sulfur oxides during or following the combustion process. Under the President's energy program, the Department of the Interior is requesting $343 million for work in these areas during fiscal year 1975, with $2.7 billion more projected for the next four years, for a total of $3 billion over the five-year life of the program.

This is a vast commitment and a rousing vote of confidence in our ability to solve the problems connected with using coal. But we need to remember that at a time when we are talking about the great need for coal, making its use one of the prime objectives of our drive to restore our energy self-sufficiency, and spending billions of dollars to promote its utilization, coal production is declining, and has been for the past 3 years.

Let me hypothesize a bit. Assume that we really do triple coal production over the next 11 years. To get to this level of 2 billion tons we would need to open 280 new mines, each averaging 5 million tons a year, just to take care of the increase, let alone compensate for depleted mines and sections in the existing infrastructure. This figures out to opening one new mine every two weeks, starting next Monday. It would mean a capital requirement of between $20 billion and $30 billion, depending on the balance between surface and underground production. It will mean the recruitment and training of perhaps 200,000 to 300,000 miners, depending on productivity rates, retirements, and the surface underground balance. It will require a quota of mining engineers that will be a multiple of anything we are now producing or ever have produced in the past.

The problems are even tougher than I have outlined, because we won't be able to start the scale-up next Monday. The lead time on getting mines into production is at least 2 to 3 years for surface and 4 to 6 years for underground. It takes 1 to 2 years to train a miner and four academic years to get a mining engineer. The available time for expansion is telescoped by the net drag of these assorted lead times.

There are other problems. To date, most of the government's concern with coal production has focused upon the urgent requirement to improve health and safety conditions in the mines. We are proud of our record in this field, and we are determined to do even better in the future. But this has been one of the factors in the decline in productivity

and loss of production we have witnessed since 1969.

Between 1969 and 1971 production per man-day in underground mines fell from an average of 15 tons per man-day to 12 tons. This is a decline of 25 percent and the price of coal has doubled. Most of us are aware of this fact. But it is also true that productivity in surface mining has also slipped badly over the same period--by about 20 percent, and the price of surface mined coal has risen by half since 1969. Stricter requirements for environmental protection and reclamation of surface-mined areas will, I expect, further cut into mining productivity and raise mining costs.

Now does this mean that we must compromise the gains we have made in environmental protection and worker health and safety for the sake of greater mine production? It does not. What it does mean is that we must now redouble our efforts to raise productivity by more efficient mining. There is much to do in the way of solving the problems that now limit the productivity of the extraction phase of coal operations, both underground and surface. The Department of the Interior has requested $47 million in research and development funds this year to assist the coal industry in solving these problems, and over the next five fiscal years the total may exceed $300 million. We are aiming not only at upgrading present mining methods, but developing new technology and new systems, and we're not shooting for peanuts. Our hope and objective is to double the productivity rate of 12 tons per man-day in underground mines, and do it between now and 1985.

One of our major efforts is to develop and demonstrate the technology needed to make longwall mining more generally suitable for use in the United States. Longwall got off to a pretentious start in the 1960's, but the bloom was off by the end of the decade and it currently contributes less than 3 percent of total production. We think it has great possibilities, particularly if it can ultimately be automated.

We feel that a lot can be done to improve haulage, and we are aiming at a system that will provide a continuous flow from the mine face to the preparation plant. This would do away with one of the major bottlenecks in underground production and allow productivity and safety increases all along the line.

Roof support is another major area we are concentrating on, since roof falls kill more men and the inability to provide continuous roof support is the limiting factor in more mines than any other single

thing. Methane has always been a problem and it is going to get worse as mines go deeper and production rates increase. If we can develop an effective de-gasing and recovery system we can contribute to solving two problems, not just one.

The list is a long one. There is a bonanza waiting for us if we can learn how to mine the thick seams in the West, and we have money committed to this objective. Underground gasification could make productive use of resources now unrecoverable. We shall investigate systems for rapid restoration of overburden behind the extraction process in surface mining. These and many other programs are evidence of our active interest in improving the technology of coal mining.

But there are other problems that must be solved, and none is more important than to remove the uncertainty over government policy that has demoralized the coal mining industry for years. We simply must have some long-range, reliable ground rules on what will be permitted in the way of surface mining and under what conditions. The Administration has proposed an approach which will get to this objective in ways which are compatible with the special economic and environmental requirements of each of the principal coal mining States. The proposal has been before the Congress for three years. Meanwhile, numerous other legislative proposals have been introduced. Many unsound, others openly punitive, still others completely prohibitive of surface mining operations. Is it any wonder that coal companies and their banks are unwilling to risk capital to open new mines in such a climate of uncertainty and abuse?

Let me cite another example. The sulfur emission standards developed by the various States under the Clean Air Act Amendments of 1970 are due to go into effect on July 1, 1975. The Bureau of Mines has recently completed an exhaustive study which will shortly be published as a Mineral Industry Survey which analyzes the standards set by State Implementation Plans for each Air Quality Control Region. It then compares the sulfur content of the coals that are available to each of these AQCR's with the established emission standards, region by region. The conclusion of the study, backed by detailed analysis, is that under the best of presently foreseeable conditions a minimum of 200 million tons of coal a year cannot be burned after June 30, 1975, under the law which takes effect fifteen months from now. The study further concludes that this unusable fraction could range as high as 250 to 295 million tons a year between 1975 and 1980.

I want to emphasize that the stock mumbo-jumbo about whether these amounts are identified with the so-called "primary" or "secondary" standards does not apply here. The figures I have given represent the amounts of coal which may not, under penalty of fine or imprisonment, be burned after June 30, 1975 under the existing law. These are the amounts that will have to be foregone under the State Implementation Plans that are now effective.

Strict enforcement of the clean air law would result in shutting down half of our coal-fired electric generating capacity and a good part of our industry. Obviously, relief will have to be granted. But where, under what conditions, for how long, and applicable to what classes of users? Coal mines can be financed only through some sort of assurance that a market will exist long enough to amortize the investment. The uncertainty as to what we will do meantime paralyzes the investment decisions not only of the coal companies but of the railroads and utilities as well. Suspense is literally killing the coal industry. Banks and bondholders are going to demand something besides sporadic short-term variances as a condition for financing new coal mining ventures. We are never going to get the investment required even to maintain coal production at its present levels--let alone a 200 percent increase--in the present environment of confusion and uncertainty over the long-term outlook for capital committed to coal mining ventures. Something has got to give, and soon.

Last week the Administration transmitted to the Congress a number of proposals designed to correct the defects of the Clean Air Act without sacrificing its commendable objectives. Among the proposals are measures designed to give stationary sources additional time to comply with the established standards, but only when these sources are on a fixed schedule for full compliance, and to permit the use of tall stacks and fuel-switching to meet ambient air quality standards, providing all requirements for the protection of public health can be met. These measures are essential to avert the impending collision between the irresistible force and the immovable object fifteen months from now, and to give the coal industry, the railroads, and the utilities some consistent realistic guidelines as to what to expect from the Federal government in the way of air quality controls.

I have mentioned two basic requirements for meeting the demands for added production in the years ahead--realistic, coherent, long-range government policy and improved mining technology. There are many others: labor stability, access to capital, improvement of the transport linkage between producer and consumer, and perhaps most important of all, the development of a large corps of dedicated, professional mining engineers.

We need what I have termed a "national coal strategy" to get it all together. A task force comprised of representatives from a number of government departments and agencies is now being assembled to develop such a strategy; assess what will be needed to get from where we are now to where we want to be; and to develop specific goals and means of achieving them.

The group will be chaired by Dr. Thomas Falkie, who has just assumed his new duties as Director of the Bureau of Mines, and its charter will cover everything from the working face in the mine to the precipitators and scrubbers in the stack. I envision the task force as a gadfly--to be the constant witness for coal to labor, to the industry, and to Federal and State agencies concerned with coal in any way. You will be hearing more from this group in the future.

There is one more thing. The coal industry has been suffering the general troubles of an industry long in decline: lagging technology, an aging labor force, a lack of capital, and a general reluctance of up-and-coming young people to have much to do with it. Now, its hour has struck. The turnaround is here, and all of a sudden there isn't enough of anything. This will place a tremendous responsibility on the corps of professionals who comprise the technological leadership for the mining industry--not only those actively working in the mines, but those in mining equipment companies, in laboratories, classrooms, and in the regulating agencies of State and Federal governments. It is these people who must separate the dreams from the realities, who know what is do-able and what is not, and who must devise the ways of getting to the objectives that must be met.

And they will be well paid for their services. Beyond the money, which is always welcome, there is the satisfaction in knowing that there is no occupation where you could contribute more to the solving of the Nation's most pressing problem: that of providing itself with an adequate, reliable supply of energy. The problem will be around for a long time, and so will the demand for the services of those who can contribute to its solution. You couldn't be in a better spot.

After years of long-suffering and neglect, the mineral science colleges are also being challenged as never before. Last June, 260 baccalaureate degrees in mining engineering were awarded--a small number when compared to the number of lawyers the colleges turned out, but it was two and a half times the number of mining engineers that were graduated in 1970. And they all had well-paying jobs waiting for them when they got out--which couldn't be said of the lawyers. West Virginia University has long been a leading contributor to the ranks of mining engineers, particularly those who enter the business of coal mining. Moreover we maintain a close and valued relationship with the University's School of Mines through our Morgantown Energy Research Center operated by the Bureau of Mines. You have helped us greatly in the past; we hope that you will continue to do so in the future, and that in turn we may be of some assistance to you as we work together to solve the tough problems which now limit our ability to use our greatest fuel resource.

I am confident that the problems will be solved, by the professionalism, the imagination, and the dedicated hard work of the far-reaching fraternity of mining. Mining--particularly coal mining--is a vital, constructive, essential occupation which has deserved far more credit than it has received in recent years. But the long-overdue recognition is on its way. The only direction things can go is up, because the Nation, at long last, has finally begun to Dig Coal.

# # #

COAL'S PROBLEMS

I. ENVIRONMENTAL

II. HEALTH AND SAFETY

III. PRODUCTIVITY

IV. LABOR-MANAGEMENT

V. PRICE CONTROLS

VI. TRANSPORTATION

VII. CAPITAL AVAILABILITY

VIII. UNCERTAINTY

Brief Narrative of Coal's Problem Areas

I. Environmental

The prime constraint to increasing or maintaining the status quo of coal's role in the utilization of fuels to meet U.S. energy needs is the environmental rejection of coal as a base fuel. The societal rejection of coal continues despite the most pessimistic forecast of coal's important role at least through the end of this century.

The widespread acceptance of coal as a base fuel does not imply that environmental aspects of mining and utilization should be disregarded, but rather that effective steps must be taken to enact equitable and enforceable policies consistent with the energy needs of this Nation. These policies would include the establishment and enforcement of reasonable environmental protective regulations relative to underground and surface mining of coal and as to the limits imposed on the inherent qualities of the coal product that can be produced from domestic sources.

II. Coal Mine Health and Safety

Protection of the coal miner's health and safety cannot be compromised. An historical review of coal mine health and safety statistics supports the Departmental policy of establishment of health protection for the miner and toward regulation of mining within the limits of safe mining policies, etc.

Enactment of the 1969 Coal Mine Health and Safety Act has as its objective the maximum protection of the coal mine worker. However, periodic review of the mine health and safety legislation and established safety measures should be made with a view toward amendment of the Act and adaptation of new mining practices where demonstrated technology indicates that higher productivity, monetary savings, and other attributes are attainable that would serve to increase the availability of coal supplies.

III. Productivity

Productivity in this context is the rate of coal production expressed in tons per man-day per productive worker.

Prior to 1969 the coal industry experienced a steady increase to 15.61 tons/man/day in underground mine worker productivity. In 1969, however, the upward productivity rate trend reversed and suffered a sharp deline to 13.67 ~~3.76~~ tons/man/day. Productivity declined further in 1973 to 11.91 tons/man/day.

While several interrelated factors may be responsible for these declines, the largest contributing factor has been assessed as the enactment of more stringent mine health and safety legislation that added employees whose chief functions were related to health and safety enforcement.

Means to improve the productivity output of the production oriented employee must be sought and put into practice. Possibly the maximum utilization of improved mining technology such as longwall mining and mine lighting, and safety interlocks, etc., where applicable could be permissable. Another factor that has served to reduce worker productivity is the influx of new and inexperienced miners. Possibly more intensive basic training might serve to improve productivity.

IV. Labor-Management

The year 1974 is a crucial one for coal. Increased coal supplies will depend to a large degree upon the ability of management and labor to negotiate a workable agreement that will serve to avoid work stoppages as a result of wildcat strikes and/or failure to reach agreement on other issues of mutual interest.

The availability of manpower and the training necessary to provide adequate skilled labor is a hurdle to be faced by management.

V. Price Controls

Price controls serve to restrict incentives to produce coals from marginal mines, whose operations are more costly per ton of coal mined. If the price of coal is allowed to reflect these higher operating costs, many small mines, whose total aggregate tonnage is sizeable, might be expected to start production. The coal shortage of 1970 was short-lived and a more serious situation was averted by operation of these mines and the marketing of coals at elevated prices.

VI. Transportation

Adequate transportation is another major key issue that cannot be neglected. These include transportation facilities to transport coal from the mine to the ultimate consumer by rail, water, truck, and pipeline.

The continuity of coal production at the mine depends upon the availability of an adequate transportation system to move the coal from the tipple or coal processing plant. Failure to have such a system results in mine shutdowns and lost production that normally cannot be recovered at that specific mine.

VII. Availability of Investment Capital

The enticement of investment capital is one of management's largest problems. Our free enterprize system causes investment capital to gravitate only to those enterprises which indicate a favorable return on investment.

The present opinion of investors is that the coal industry is a high risk business venture even in light of a clear indication the present (1973)

coal production must be increased by a factor of 2 or 3. The issue that appears to be left unanswered by the forecasters and policy makers alike is any assurance that coal is included in the fuel demand picture over the period of time required to amortize these investments with the expectation of a reasonable profit.

VIII. Uncertainty

Uncertainties include such areas as the availability of adequate mining supplies to operate the mines. These supplies include equipment, replacement parts needed for equipment repair and timing on delivery of strategic materials such as roof bolts, which are required by law in underground mining, and other mining supplies such as blasting agents, etc. Recent price controls placed on selected supplies and subsequent actions by the Cost of Living Council to allow increases on selected commodities have interacted to limit or cease production of mining supplies in favor of more profitable commodities.

WHAT CAN BE DONE TO IMPROVE COAL'S POSITION

ADOPT REALISTIC AIR EFFLUENT REGULATIONS.

ENACT LIVABLE BUT THOROUGH STRIP MINING REGULATIONS.

REVIEW HEALTH AND SAFETY LEGISLATION

--REFLECT NEW TECHNOLOGY WHERE APPROPRIATE.

ACCELERATE AND IMPROVE TECHNOLOGY

--SURFACE AND UNDERGROUND

--SO_2 REMOVAL

--CONVERSION TO CLEAN SYNTHETIC FUELS.

REVIEW LABOR-MANAGEMENT PROBLEMS.

ENCOURAGE MANPOWER TRAINING AND SUPPLY.

IMPROVE TRANSPORTATION.

IMPROVE EQUIPMENT AND MATERIALS SUPPLY.

ESTABLISH A NATIONAL POLICY OF BASING POWERPLANTS ON COAL & NUCLEAR ENERGY.

REMOVE PRICE CONTROLS.

ADOPT REALISTIC FEDERAL LEASING POLICIES.

ESTABLISH INCENTIVES TO DECREASE INDUSTRY UNCERTAINTY

--REMOVE UNCERTAINTIES AND ASSURE INVESTMENT RECOVERY.

Narrative on What Can Be Done to Improve Coal's Position

Several action areas are recognized which need prompt attention and the establishment of firm policy to improve coal's position. Each of these problem areas must be dealt with effectively in order to reach the President's announced objective to attain a self-sufficiency status for adequate fuel supplies from domestic sources by 1980.

Areas where positive action should be initiated and policy formulated are defined as follows:

I. Adopt Realistic Air Effluent Regulations.

The major loss of coal's established traditional markets and future utilization of coal, primarily as a boiler fuel to generate electrical energy, can be attributed directly to coal's inability to meet established environmental restrictions. The most severe restriction imposed on the quality of environmentally acceptable coals is that related to the sulfur content of the coal or the permissable concentration of sulfur dioxide (SO_2) emission from coal combustion systems.

A policy should be established to review established environmental restrictions that have been legislated by several States. The study should be made with the view toward gaining desirable environmental goals over a more realistic time frame (i.e. by 1985), in recognition of available supplies of domestically produced fuels.

II. Enact Livable but Thorough Strip Mining Regulations.

Much of the criticism leveled at today's surface mining operations are predicated on past strip mining operations conducted by unscrupulous coal operators. Present day surface mining operators are willing to restore the mined areas to productive uses. A policy should be established to work toward the objective of enactment of realistic land restoration legislation and delineation of selected areas where surface mining should be prohibited.

III. Review Health and Safety Legislation.

Safeguarding the health and safety of the miner is an absolute requirement and cannot be compromised. The 1969 Coal Mine Health and Safety Act is a milestone in attaining that objective. The provisions of the Act should not be construed to be unchangeable in the light of advancing technology. The Health and Safety Act must be flexible enough to permit changes in the Act where it is indicated clearly that such changes would not weaken the overall objectives of the Act per se. An example of such an indicated change is in the improvement of lighting by the use of fluorescent lighting fixtures which now are prohibited by the Act. A review of the Act is indicated to be in order and controversial areas of the Act should be evaluated as to their impact on the miners' health and safety.

IV. Accelerate and Improve Technology.

The phenomenonal growth in a National average coal productivity rate in the last two decades from 7.47 tons per man per day in 1952 to nearly 20 tons per man per day in 1969 was the result of rapid technological developments in the coal mining industry. Since 1969, however, productivity has declined sharply to 17.74 tons. Several developing factors are being assessed which may well increase the present coal productivity rate to its former level or higher. Such gains can be realized only if applied R&D is permitted to take place and R&D is adequately pursued in the areas of more novel concept of coal recovery methods.

Other R&D areas, that are not directly related to the mining of coal per se, will need to be vigorously pursued and expanded. Coal can be burned without societal objections if the combustion gases can be cleaned before discharge into the atmosphere or if the coal can be converted to a cleaner burning fuel. Both of these areas are the subject of R&D. A more intensive program is indicated.

V. Review Labor-Management Problems.

Management and labor have obligations to the respective groups they represent. Both management and labor must maintain strong positions in order to deal effectively with their segments of the economy. Assistance must be forthcoming from Government to attain equitable and just negotiations for the coal industry.

VI. Encourage Manpower Training and Supply.

Coal mining as a profession has suffered from a societal viewpoint. Mining is an honorable and skilled profession, whose image must be improved to the public. Today's miner is a highly skilled professional. He must be trained, often for long periods of time, prior to reaching the proficiency needed to operate the highly complex and expensive equipment used to mine coal. An intensive effort should be made to assure an adequate supply of manpower through the establishment of mining technology centers to train the miner.

VII. Improve Transportation.

Often it has been said "that a chain is as strong as its weakest link." That axiom applies equally well to an adequate transportation system.

A concerted effort must be made to retain the present U.S. railroad, barge, and trucking systems needed to move coal from source to consumer. In addition, incentives to assure an adequate future capacity for all modes of transportation is indicated. Novel concepts, i.e. pipelines, should be studied more intensively to determine their potential in the movement of coal.

IX. Establish a National Policy of Basing Powerplants on Coal and Nuclear Energy.

The United States, in order to remain in a dominant world power position, must establish a policy of self-sufficiency for fuel supplies. Coal is our most readily available base fuel to permit such a policy. The operation of this Nation's electric utility network is most crucial. Dependence on fuels from foreign sources in times of international periods of unrest can lead to many uncertainties. A policy to establish self-sufficiency for fuels must by necessity offer the incentives needed to develop coal reserves.

X. Remove Price Controls.

Removal of controls are not restricted to coal pricing per se. Included are the controls that are imposed on strategic mining supplies, i.e. roof bolts, blasting agents, and other essential daily supplies needed to mine coal.

XI. Adopt Realistic Federal Leasing Policies.

The Federal Government holds title to vast deposits of coal that could be developed commercially. The Government should conduct a critical review of its leasing policies. Much of the future development of western coal reserves are dependent upon development of Government held reserves.

XII. Establish Incentives to Decrease Industry Uncertainty.

RECOMMENDED NATIONAL POLICY ON USE OF COAL IN THE 70'S

The following excerpts are taken from the report of the Cornell Workshops on the national issues of the National Energy Research and Development Program held September 14 to October 17, 1974. The excerpts are taken specifically from a section on the coal option, pages 23-26. The membership list of the workshop on the Fossil Fuel Option is attached.

Excerpts on the Coal Option

(Increased Coal Production: Goals)

A principal aim of our energy policy for the forseeable future is to increase the role of coal in the economy...

Annual production rates of coal (bituminous and lignite) amount to approximately 15 mQ or 600 million tons...

Through a combination of some surface mining, but mostly underground mining, eastern sources could reach levels of 800 million tons annually by 1985. This should be compared with the current 300 million tons of underground mining plus 240 million tons surface mining (approximately) in the East...

It is estimated that inside of three years machinery and men could be in place to accelerate production to levels where western sources could supply close to 1,000 million tons annually by 1985...

We would like to set target figures for coal to supply annually 30 mQ by 1980, 45 mQ by 1985, and reach 60 mQ per year in the later part of the century. Whether it is realistic to assume that coal production can double within this decade and triple by 1985 is open to some question.

(Increased Coal Production:Barriers)

Rapid expansion of underground mining faces some serious technological obstacles. Improvements in underground mining have lagged, recent research has concentrated on improving the miner's health and safety--an essential element to maintaining the viability of the industry. Meanwhile, productivity has dropped significantly and improvements are badly needed. This can be accomplished by introducing modern technology, much of which has yet to be tried on a large enough scale and some of which has yet to be fully developed. A major R and D program on underground mining must be mounted in order to

reduce over-all costs and increase efficiencies. One hopes that recovery rates can be appreciably improved over the present 50 percent norm and that productivity per miner can be gradually increased by a factor of two over the next twelve- to fifteen-year interval...

The coal industry faces a most severe challenge in trying to expand its production capacity at the rates we have projected; but, its efforts would be fruitless unless the required markets could be supplied for its product over the same time scale...

The principal obstacles at the moment, aside from marketability questions, are environmental considerations...

(Increased Coal Use: Combustion Technologies)

One of the quickest and most effective ways to reduce shortfalls in gas and oil is to substitute coal for them under electric utility and industrial boilers...

The least path of resistance to substituting coal for oil and gas should be experienced in the electric utility industry...

What fraction of presently installed gas- and oil-fired boilers can be converted to coal depends in part on in what form coal will be supplied. In any event, there will be limitations to the degree of retro-fitting that can be accomplished. As for future fossil-fired boilers, one can in principle insist that they be built with a coal-firing capability...

Of the various schemes considered for allowing direct combustion of coal in an environmentally acceptable manner and the one which may have the widest utility in the short term, the low-Btu gasifier appears to be the likeliest candidate. There exist old technologies for gasifying coal either as such or from coke with air and steam which were used in the past for the manufacture of town gas and producer gas. The problem now is to improve upon the old state-of-the-art by incorporating certain modern developments which have come out of our high-Btu R and D program. What is required is a relatively inexpensive process for producing gas with heat content large enough so that serious boiler derating can be avoided (over 175 to 200 Btu/cu ft). The gas must be clean and the process must be able to handle coals of various ranks and sizes. In order not to loose the sensible heat of the resulting gas, a high-temperature sulfur (largely in the form of hydrogen sulfide) removal method should be developed.

Relatively little effort has gone into developing a suitable low-Btu gasification process; but, once it is achieved, it should find wide use not only among electric utilities but also with industry for the production of process heat and providing space heating.

(Increased Coal Production: An Interim Environmental Strategy)

As an intermediate measure it may be possible to restore coal to plants which have converted to oil by adopting the so-called software and tall stack strategy. This requires that emission standards be relaxed in favor of ambient standards, that during meterorlogically favorable conditions coal with higher than normally tolerable sulfur content be burned, and that there be an adequate warning system to allow the plant to switch to stand-by low-sulfur fuel when conditions alter. Many rural areas may allow for this mode of operation and to the degree required tall stacks (1,200 to 1,500 ft in height) could be erected to aid in atmospheric dispersal. This strategy has worked well in England, but its extensive adoption in the United States has met with opposition.

The art of stack gas cleanup is fairly well advanced, but its effectiveness and reliability remains to be demonstrated on a large scale. First generation schemes have certain undesirable features, among which waste disposal is a major item. We must continue to press R and D in order to develop more acceptable schemes which can produce elemental sulfur as the final disposable item. There is also room for innovation, since medical evidence seems to indicate that it is the small particulates in combination with sulfur oxides which is harmful to humans and not the latter by itself.

It has been proposed that advanced combustion using the techniques of fluidized beds along with chemical scrubbing offer an alternative to stack gas cleanup. It has the attraction of offering a more compact and more elegant solution to the sulfur oxide supression problem, but the art is still in early stages of development and the research programs supporting this effort are somewhat fragmented and uncoordinated. Advanced combustion techniques come with an energy penalty in that some 35 percent of the coal's original heat content will be lost in the process. By comparison, the stack gas cleanup processes now under consideration are expected to cause a 5 to 8 percent reduction in plant efficiency.

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ADDITIONAL EXCERPTS FROM THE CORNELL WORKSHOPS ON THE NATIONAL ENERGY RESEARCH AND DEVELOPMENT PROGRAM

Chapter II. The Fossil Fuel Option

Harry Perry, National Economic Research Associates

(Excerpts pp. 81-86)

COAL MINING

Using the above projections of demand and production of fuels other than coal and if oil and gas imports are to be kept at 1970 levels (8.4×10^{15} Btu per year), coal will have to supply 43.1×10^{15} Btu per year (1.8 to 2.1 billion tons, depending on the Btu value of the coal actually mined).

An estimate was made of whether coal mining could be expanded from its present 0.6 billion-ton level to 1.8 billion tons per year by 1985. For this estimate the following assumptions were made:

- Any environmental constraints would either have been eliminated or waivers granted.
- There would be no coal resource constraints as a result of federal leasing policies.

- There would be no capital constraints, since guaranteed markets or other incentives would be provided.
- Full cooperation of the labor and industry in the program.

STRIP MINING

Approximately 300 million tons of coal were strip mined in 1972. The major constraint to expanding production is the rate at which large draglines can be manufactured. In 1972 draglines capable of moving 250,000,000 cubic yards per year were produced. The present ratio between cubic yeards removed and tons of coal produced is fifteen to one. In the future, it is expected to be reduced to about twelve to one, or less when mining the thicker coal beds of the West. Thus, the present yearly new capacity of draglines could produce seventeen million tons of coal per year. With no increase in dragline production capacity, this would become twenty-one million tons per year when the ratio changed to twelve to one. Currently, some of the draglines are being exported and others are being used in projects other than coal mining. The present percentage distribution is about 65 percent for domestic coal, 20 percent for export coal, and 15 percent for noncoal use.

There are two large dragline manufacturers, with a third company trying to enter the market. It now takes about two years for delivery of draglines from the time of purchase. After arrival on the site, it takes about six to eighteen months to erect the equipment. Both of the large manufacturers believed that it would be possible, under the assumptions above, to increase productive capacity by two times in two to four years depending on how easily new space could be found and on how much subcontracting was used.

A doubling in production capacity is actually in the planning stage by one of the companies, to be achieved by 1980. A doubling of coal production should be possible even by 1980 if the needed incentives were provided. The time to train personnel required is only one to two years; thus, manpower considerations should not reduce the estimates of what could be accomplished. Strip mine

production of about one billion tons by 1985 would not be constrained by dragline equipment deliveries. Based on the equipment delivery time, strip production of 650 million tons in 1980 and 1.08 billion tons by 1985 should be possible if all new draglines are dedicated to domestic use (see Appendix A).

The only long-term delivery item for their production lines are large gear cutters; they are now being delivered in eighteen months. With an assured market, they were certain that gear cutting machinery manufacturers would be able to deliver fifty units and that this would not be a constraint on their ability to manufacture draglines.

None of the large coal companies could see any problem with obtaining the number of strip mine employees that would be required, although in the early years there might be some shortages as production moved into areas where the labor pool was small. With an average productivity of fifty tons per day in 1980, only 46,000 miners would be required -- or 11,000 more than now employed in strip mining. The time necessary for full development would be about three years after delivery. One large mining company was confident that the doubling of coal production was easily attainable by 1980 and that if all efforts were properly coordinated, the increase could be greater. This same official thought that it would be possible to have 750 million tons by 1985 and that production could even be higher. Although the problem was not thought to be as severe as for underground mining, the shortage of mining engineers was one of the problems that would require more lead time and planning if it were to be avoided.

Reclamation of the disturbed lands when area mining is used in the areas where rainfall is abundant has repeatedly been successfully demonstrated. As the demand for coal increases to satisfy our energy requirements, an increasing share will come from western strip mines which are frequently in arid areas. Methods to reclaim many of these lands and restore them to an acceptable condition should be possible if reclamation methods are a part of the overall mining plan. Demonstration of various methods to successfully restore strip mined lands in arid areas should be

undertaken immediately so that the policy makers are certain that these resources can be utilized in an environmentally acceptable manner. Such demonstration projects would require several million dollars per year for five to ten years.

Supplementary Comments by Ernst R. Habicht, Jr., Environmental Defense Fund, Inc. (EDF):

Given the patchwork nature of federal and state leasing policies in the western United States, the lead time for construction of railways, and the certain economies of scale -- in preplanning, mining, coal haulage, rehabilitation, and monitoring -- it might well be desirable for the federal government to start swapping lease holds in order to concentrate development in those areas with rich coal seams that are most susceptible to rehabilitation. Furthermore, such an argument dictates that future federal and state leasing policy be better coordinated and take a more holistic perspective, since it is leasing and prospecting permit policy that set in motion a chain of events that will ultimately produce either rehabilitated productive land or a "national sacrifice area."

UNDERGROUND MINING

The lead time and anticipated problems of increasing underground mining production capacity are much more difficult than for strip mining. Manpower is more limited and more difficult to train than for strip mines. The need for trained mining engineers is much greater underground and they are certain to be in short supply for some intermediate period, because it is already too late to attract and train the number needed by the latter part of this decade. Underground miners will take two to three years to train.

The lead time for obtaining and operating underground mining machinery is currently much less than for draglines. New equipment can be obtained in six months. It requires three years to get production at a mine to the point where it is about half of its rated capacity and four or five years to reach full capacity. Although there are a limited number of companies that are able to drive shafts, this should be no constraint on new underground production. Training new personnel could be done in

several years if they are needed.

The operators of the two large coal companies did not see any difficulty in doubling underground capacity by 1980 and even redoubling that by 1985 under the assumptions listed above. Both stressed, however, that new technology would be required for the second doubling. The present bottleneck in developing new mines is entry development and to double the productive capacity between 1980 and 1985 will require the introduction of new, more rapid tunneling machines and the use of degasification techniques in advance of mining.

Underground coal mining technology offers opportunities for further improvement and most of the research currently underway has been restricted to the important, but narrow, goal of improving health and safety underground. Although western coal deposits will become an important source of domestic fuel supplies, the eastern coals, now supplying over 90 percent of all coal produced will continue to remain a major source of coal for the next several decades. Much of this will be produced from underground mines using methods that could be greatly improved and at lower costs if fundamentally new underground mining technology was developed.

The need for improving underground mining techniques will be accentuated by the greatly increased demand for the production of liquid and gaseous fuels from coal. The program should include (1) basic research to increase our fundamental knowledge of the geologic conditions to which the mining systems must respond, (2) finding solutions to specific problems with which the mining industry is now faced, (3) development and testing of new hardware that would be needed for new mining systems to be developed, and (4) demonstration on a full scale of the applicability of new equipment and new mining systems.

The basic studies should be heavily concentrated in university laboratories. This would serve the dual purpose of developing such information where it traditionally has been developed and would revitalize the mining curricula at universities which has fallen into a state of near collapse.

Among the specific research problems that should be undertaken for which solutions are now needed are explosion suppression systems, improved methods to fight mine fires, removal of methane in advance of mining,

development of rapid and safe excavation techniques (shafts and tunnels), advanced methods to remove coal from the face to the main haulageway, and dust suppression systems.

New methods for mining coal that increase recovery and improve safety and productivity will require new types of hardware to be developed. New mining systems to achieve these goals should be studied and the research to produce the new equipment required should be undertaken. All of the new developments resulting from the basic studies, research on specific problems, and on new mining systems and equipment should be demonstrated in a working, full-scale mine. Costs for the new mining research would be $250 million over five to ten years.

With the introduction of these new technologies and improvements in face haulage machinery, average underground productivity should increase from twelve tons/man-day in 1972 to eighteen tons/man-day in 1980. If all the technologic improvements could be achieved, productivity could reach twenty-four tons/man-day in 1980. Thus, to produce twice as much underground coal by 1980 would only require an increase in the labor force from 100,000 to 150,000.

Five Engineering Task Force Reports

Task Force	Chairman
Coal Mining Technology	Mr. Eugene Palowitch U. S. Bureau of Mines
Coal Preparation	Mr. Robert D. Saltsman Bituminous Coal Research, Inc.
Combustion Technology	Dr. Robert Essenhigh Pennsylvania State University
Tall Stacks and Supplementary Controls	Dr. Robert Dunlap Carnegie-Mellon University
Flue Gas Desulfurization	Mr. John Tieman Bituminous Coal Research, Inc.

INTRODUCTION

Dr. William Steigelmann, Technical Recorder
Franklin Institute

INTRODUCTION

During the past quarter century, coal mining, especially of anthracite, has declined sharply in the Commonwealth of Pennsylvania. At the same time, the national need for energy has increased to the point where it is no longer met by available supplies, including imports. In view of the changed circumstances, renewed use of Pennsylvania's coal resources has become a matter for urgent consideration both as a national responsibility and for the benefit of the people of the Commonwealth. Pennsylvania's energy needs and recommended approaches to satisfying them have been set forth in the Executive Summary Report by the Governor's Science Advisory Committee, *Energy for Pennsylvania, An Action Plan for Energy Management in the Commonwealth of Pennsylvania*, September 1973.

With this background, five task forces have been organized to study various aspects of the problem of choosing the best current coal technology. Under the sponsorship of the Department of Commerce, Commonwealth of Pennsylvania, the task forces are funded by a grant from the Pennsylvania Science and Engineering Fouancation.

MINING, ENERGY USE, AND ENVIRONMENT

Figure 1 shows the relationships between (a) coal mining and (b) energy use and environmental impact. Energy is consumed in all industrial operations including coal mining. The various forms of mining operations (e.g. deep mining and strip mining) yield coal which must go through various stages of preparation and treatment, transportation and distribution, and final use, before useful output result. The useful output may result from the

chemical properties of coal or coal products (e.g. coke, steel), or it may be heat resulting from combustion of coal as a fuel. Each of these stages entails some loss or environmental impact. For example, not all the coal is recovered in the mining operation itself, and mines are a source of acid mine drainage and esthetic damage to the land. Some coal is lost in coal cleaning and preparation, and waste products are produced that must be disposed of. Use of coal as a fuel produces solid products as well as flue gases that are a potential source of air pollution, primarily because of the sulfur present in the coal.

TASK FORCE SUBJECTS

The health and safety of those working in the mining industry, as well as of the public at large, are the common denominator of the task forces. It is clearly necessary that health and safety be addressed in the light of economic and technological realities, if Pennsylvania's coal resources are to be put to their best use.

The task force subjects are listed in Table 1. The principal use of coal is as a fuel. Since most of the coal in the ground is high sulfur coal, the control of stack gas sulfur content is the central theme of the first three task forces listed in Table. 1. Each of them is concerned with some stage of preparation and use. The task force on Coal Preparation is concerned with removal of sulfur before combustion , the task force on Flue Gas Desulfurization is concerned with removal of sulfur during and after combustion, and the task force on Tall Stacks and Supplementary Controls is concerned with mitigating the impact of the sulfur that remains in the stack gases. Because the approaches discussed by the first

two task forces are relatively costly, they are most suitable for large consumers of coal such as electric power generating plants. The task force on Combustion has as its topic the conversion of coal to a pollution-free gaseous fuel that can then be used to provide heat for industrial processes (particularly those of medium-size industries) as well as for steam production for electric power generation and the process industries. The task force on Mining Technology is concerned with the economic, technological, regulatory, and human factors constraints associated with an expansion of mining activities.

The problem undertaken by the task forces is urgent. The abrupt end of the long period of cheap and abundant energy in the nation, which was experienced in 1972-73, brings with it impacts on industrial activities; especially on those which are energy intensive. Every effort must be made to use the resources of the Commonwealth to mitigate this impact, to avoid severe economic reprocussions and to help ensure economic viability while simultaneously ensuring that the health and safety of the workers and of the public are protected, and that the environment is not damaged.

This report summarizes the principal conclusions and recommendations of the five task forces.

Table 1.

LIST OF TASK FORCES

	TASK FORCE SUBJECT	CONCERN
1.	Coal Preparation (Beneficiation)	Sulfur Removal Effectiveness, Costs, Energy Losses
2.	Flue Gas Desulfurization	Sulfur Removal Effectiveness, Costs, Availability and Reliability of Equipment
3.	Tall Stacks and Supplementary Controls	Sulfur Dispersal Effectiveness, Costs, Regulatory Constraints
4.	Combustion	Availability of Equipment, Status of Alternative Approaches, Costs
5.	Mining Technology	Constraints on Expansion of Production, Health and Safety, Environmental Impacts

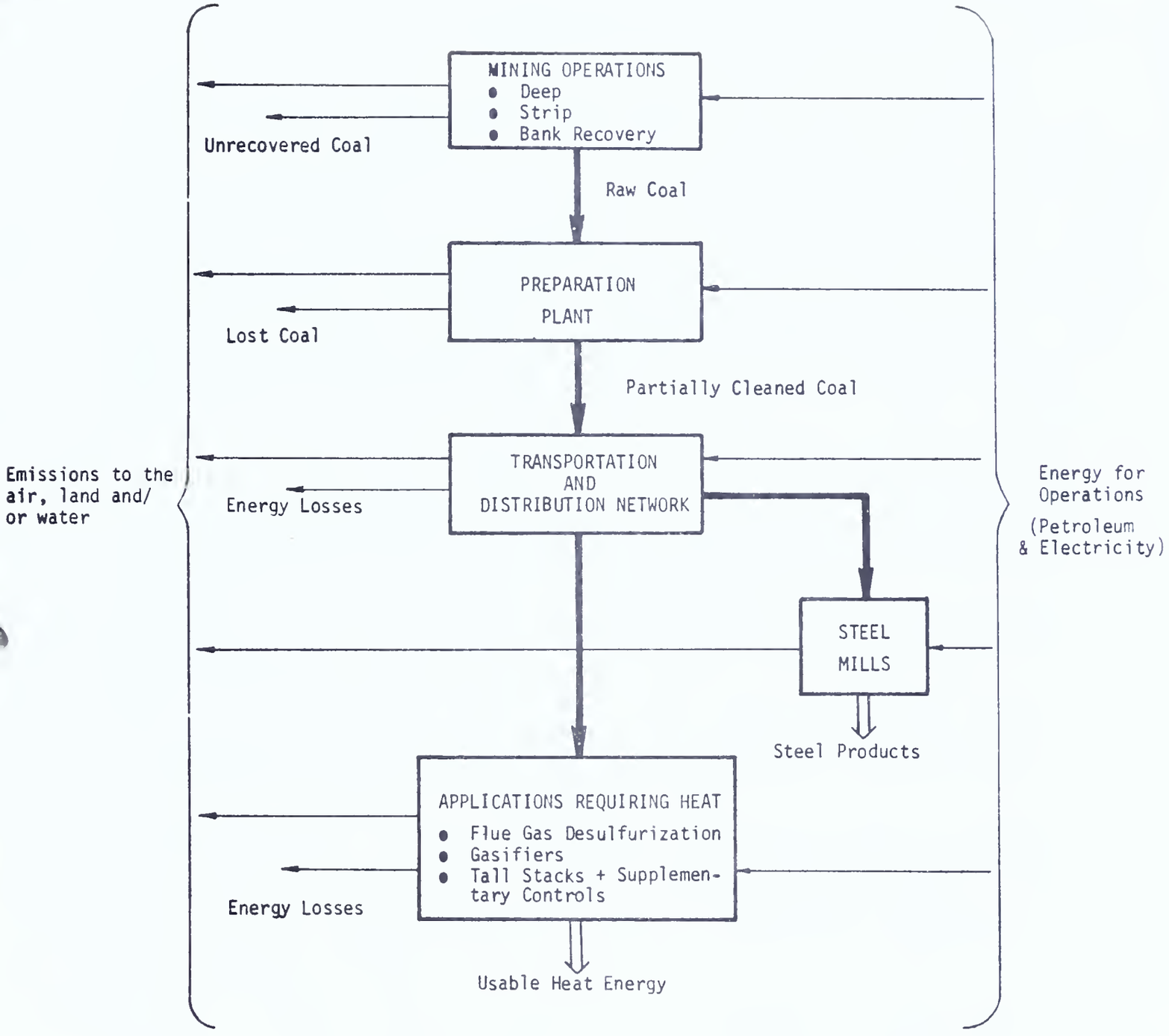

Figure 1: Coal Utilization Flow Sheet

PENNSYLVANIA TASK FORCE REPORT
ON
COAL MINING TECHNOLOGY

SUMMARY STATEMENT

The Task Force believes that it is possible to increase coal production in Pennsylvania from about 82.5 million tons per year in 1973 to about 100 million tons per year by 1980.

Accomplishing this goal will require: (1) An investment by the coal industry of millions of dollars to expand current facilities and to develop new facilities; (2) the recruitment and training of additional personnel to operate these expanded and new mines; (3) that some allowances be made for burning the Commonwealth's higher sulfur coals; and (4) that the Federal and State regulations concerning the environmental impacts of the mining industry and the health and safety of its workforce be administered fairly.

RECOMMENDATIONS

1. Take whatever actions deemed necessary to promote the execution of long-term contracts for Pennsylvania's coals to guarantee a reasonable return on capital invested in expanded and new coal production facilities.

2. Permit the burning of coals containing more than about 1.2 percent sulfur so long as prevailing ambient air quality standards are not compromised.

3. Aid the industry in the training of all levels of personnel needed urgently by the coal industry to include miners, mechanics, electricians, supervisory personnel and engineers.

4. Review current rules and regulations designed to minimize the impacts of coal mining on the environment and to safeguarding the health and safety of coal mine workers to determine their adequacy. As indicated, these regulations should be updated and, to the extent possible, revised to conform to those of adjacent states and the federal government.

5. Encourage the development of new and improved mining methods and equipments by institutions of higher learning, mining machinery manufacturers and commercial coal companies and by expediting the approval of new and experimental equipments.

6. To the extent possible, assure the availability of the fuels, lubricants, explosives, and other supplies and materials necessary for the production of coal.

7. Promote the growth of the Commonwealth's mining equipment manufacturing capability.

INTRODUCTION

The Commonwealth's Bureau of Topographical and Geological Survey estimates coal recoverable by current technology in the state is 20 billion tons: 12 billion tons of bituminous coal and 8 billion tons of anthracite.[1] In 1973, 76 million tons of bituminous and 6.5 million tons of anthracite, or a total of 82.5 million tons[2] of coal was mined in Pennsylvania. At this rate of production, the Commonwealth's recoverable coal reserves will last for more than 240 years. Even if the production rate should double by 1990, as is forecast,[3] there will be sufficient coal to last for more than 100 years.

Three principal factors affect the rate at which coal is actually used: (1) Economics, i.e., the cost per unit of energy relative to alternative energy sources; (2) Convenience of storing, handling, and utilizing one form of energy over another; and (3) Regulations by governmental bodies which, not only influences the conditions under which coal may be mined but also the minimum quality of coal which may be utilized.

Because it contains a relatively high percentage of sulfur (usually 2-4 percent),[4] bituminous coal--which is used most frequently--produces sulfur dioxide, when it burns. Although anthracite coal is low in sulfur (0.5-0.9 percent),[4] its ash content is generally high and special and more expensive boilers are required. The availability of relatively inexpensive petroleum and natural gas, and the evolution of strict air pollution regulations, have resulted in a significant reduction in coal mining activity in Pennsylvania. The following tabulation shows a sharply declining trend in the production of anthracite coal, and a much smaller decline in bituminous coal production:[5]

Period	Annual Production, million tons		
	Bituminous	Anthracite	Total
Avg 1951-55	89.7	33.9	123.6
Avg 1956-60	74.8	23.0	97.8
1965	80.3	14.9	95.2
1967	79.4	12.3	91.7
1968	76.2	11.5	87.7
1969	78.6	10.5	89.1
1970	80.5	9.7	90.2
1973 (Estimate)[2]	76.0	6.5	82.5

The declining production of coal is particularly significant in that it occurred during a period when the demand for energy was growing at a rate of nearly 5 percent per year.

INGREDIENTS NEEDED TO INCREASE COAL PRODUCTION

The Task Force believes the downward trend in coal production can be reversed and that the three essential ingredients to production--manpower, tools of production, and a market--are at least potentially at hand. Prudent governmental activities can do much to accelerate the expansion of Pennsylvania's coal mining industry.

Manpower

Some investigators and reporters[6,7] suggest that a shortage of competent manpower for mining coal may be a significant obstacle to re-establishing the Commonwealth's position as a leading coal producer. While this may be true for the long term, the concensus of the Task Force members is that, while the number of skilled miners is lower in Pennsylvania than it was twenty years ago, this shortage does not appear to be critical to increasing coal production during this decade. The Task Force believes that the anthracite industry could increase its production by some 2.1 million tons per year but would require the recruiting of some 610 additional men--a problem which is not considered insurmountable.[8]

Closely associated with the *size* of the labor force is the matter of the *productivity* of the labor force. Productivity (tons of coal produced per unit shift) of the American coal miner has been decreasing since 1970, a sharp reversal of the pre-1970 long-term trend of increasing productivity. Overall productivity of coal miners in Pennsylvania bituminous mines fell from 14.7 to 12.8 tons per man-day between 1965 and 1972.[9,10] This reversal is attributed to three major factors: The employment of yougер, and hence less experienced miners; wildcat strikes and absenteeism; and the implementation of new mine safety regulations by the State and Federal regulatory bodies. It is interesting to note that the mining labor force (including supervisors) consists mainly of men who are either in their 20's or their 50's. The reason for this is that during the 50's and early 60's, the coal business was in a recession and few new miners entered the industry. The effect of decreasing productivity is compounded because, in order to increase coal production, it is necessary to hire more young, inexperienced men. These employees are less productive and have relatively less safe work habits than experienced miners thus leading to the need for even more men.

Frequent and lengthy visits by mine inspectors in the performance of their regulatory duties requires that face bosses and section foremen be away from their normal tasks of supervising miners. This not only results in a measurable decrease in coal production during these periods, but may also be counterproductive to safety in that the attention of the men who are most experienced in mining--the face bosses and section foremen--is diverted from providing on-the-spot supervision of the work force. Representatives of mine operators recommended that well run (good safety records) mines being inspected less frequently, with the inspectors' efforts being concentrated on those mines with less satisfactory safety performance.

Equipment

A significant expansion in coal production in the Commonwealth will require the procurement by the mine operators of expensive coal mining machinery. Manufacturers of such equipment are few in number and already have a considerable backlog of orders, with the result that delivery time on large stripping and loading shovels and underground mining machines is currently three to four years. This factor alone could constrain the production of additional coal. And, the large capital commitments associated with purchasing new machinery and the other investments connected with opening new mines are contingent upon there being a long-term *guaranteed* market for the coal. These financial commitments probably will not be made on the scale needed unless the producers have some reasonable assurance of a firm market over the twenty to thirty year life of the new mine. The investment required for a new mine ranges between $15 and $25 per annual ton of production. An investment of about $300 million will thus be needed to increase coal production in the Commonwealth by 15 percent by the end of the decade.[2,6]

The preceding discussion pertains mainly to underground mining. For the shorter-term, some increases in coal production can be achieved by surface mining, as some types of road building equipment can be used for surface coal mining which might be available because of cut-backs in the highway construction program. However, significant increases in production by surface mining as in deep mining also will require substantial investments in new equipment.

Market

Coal mine operators in the Commonwealth have seen demand for their products decline while they face higher operating costs, increasingly stringent governmental regulations, labor instability, high interest rates and prospects of even greater inflation. They have little incentive to make major investments in new or expanded production facilities unless there are reasonably firm assurances that the present increased demand for coal will persist for approximately the life of these new or expanded facilities. Such assurances are not easily obtained. Obviously, short-term variances (60-180 days) permitting the burning of high sulfur coal does little to solve this problem. If substantial oil and natural gas deposits were to be discovered on the Atlantic continental shelf, customers now competing for coal might be required by the regulatory agencies to reconvert from coal back to these lower sulfur fuels. Techniques for burning Pennsylvania's bituminous coals without excessive sulfur dioxide emissions are being developed, but these have not yet been demonstrated to be reliable and are not now commercially available.* It has been shown feasible to reduce the sulfur content of these coals to about

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* Refer to the reports by the Combustion and Flue Gas Desulfurization Task Forces.

1.8 percent by cleaning it at the mine.* The electric utility industry is the one market that wants desperately to use coal and is in a position to sign long-term contracts; but under present federal regulations it is not permissible to burn coal with greater than about 1.0 percent sulfur in new electric utility generating plants.**

FUTURE PRODUCTION

Approximately 65 percent of Pennsylvania's coal production comes from deep mines. For the immediate future (the next 3-4 years), it should be possible to achieve a modest increase in overall coal production by expanding surface mining operations and also by "re-mining" the coal fines in culm banks (principally anthracite) wasted from earlier mining operations. It is estimated that 500 million tons of material is contained in these banks which is extremely high in ash content but which can be processed to reduce the ash content to an acceptable value. For the longer term, the mining companies must increasingly depend on deep mines.[10,11] The Task Force concluded that, by 1980, it should be possible to increase bituminous production by about 13 percent, to 86 million tons per year, and double anthracite production to 14 million tons per year; an overall increase of some 21 percent to a total of 100 million tons per year. The past history and projected maximum future production are illustrated in Figure 1. It should be noted that the projected anthracite production in 1980 is the same as that of less than ten years ago. Anthracite production alone in 1917 amounted to 100 million tons.

ENVIRONMENTAL AND OTHER FACTORS AFFECTING COAL PRODUCTION

The production of any mineral commodity produces environmental impacts and entails potential hazards to miners. Problems common to the deep-mining of anthracite and bituminous coals include: Acid mine drainage, subsidence, underground and outcrop fires, the disposal of preparation plant refuse and effluents,* gob pile fires and such special hazards as tailing impoundment failures. For bituminous coal, there is the added risk of methane gas and dust explosions.

For surface mining, the major and the most highly publicized environmental impact is the scarring of the terrain. Pennsylvania's legislation with respect to restoration of strip mined land is the most progressive in the nation. It has been studied carefully by the U.S. Congress as a guide to the framing of Federal legislation regulating surface mining. Experience has shown that coal mine operators can meet the requirements

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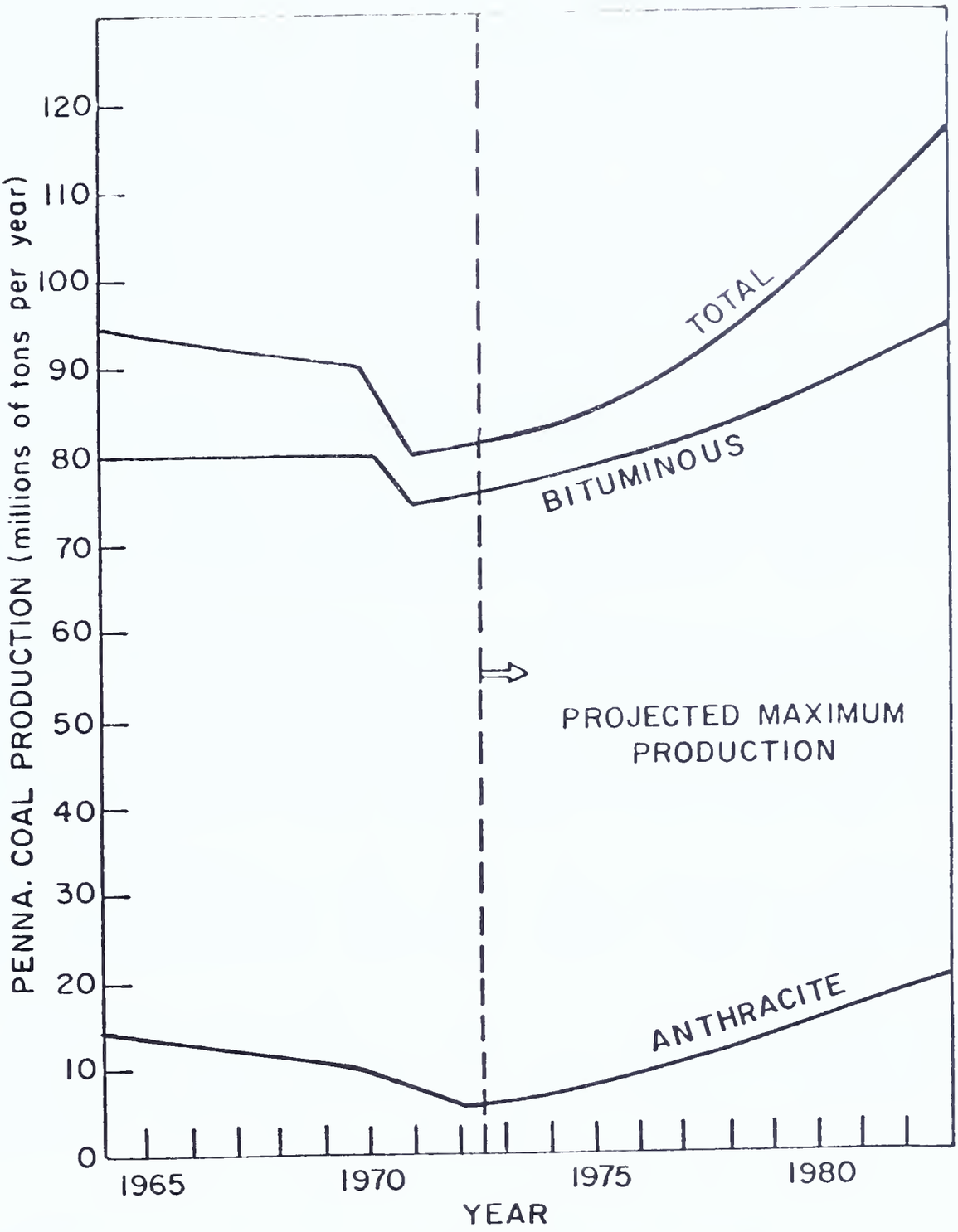
* Refer to the report by the Coal Preparation Task Force.

** The Pennsylvania Regulation stipulates a maximum allowable emission rate of 1.2 lb SO_2 per million Btu of heat released in the boiler.[9]



COAL PRODUCTION IN PENNSYLVANIA

FIGURE I

of Pennsylvania's laws and stay in business. Where the terrain at the mine site has a steep gradient (20 percent or more), water erosion of the excavated overburden can result in mud slides, silting of surface waters, and in the case of bituminous coal, the contamination of surface and ground water by leaching of acids from the spoil. Complying with the law precludes strip mining on steep slopes. One improvement suggested in the surface mining regulations is an alternative to requiring that the land be restored to its original form and permit the permanent alteration of the landscape, such as by allowing the mined site to be flooded and used for recreation or as a reservoir.

A summary of salient coal mining characteristics is presented in Table I. Note that surface mining enables the recovery of essentially all the coal uncovered, while with deep mining the recovery efficiency is markedly less, averaging about 55 percent.

In addition to the recommendations concerning the frequency of mine inspections, the Task Force also recommends that the regulatory agencies select individuals who have had several years of practical experience and give more attention to the training of their mine inspectors. While many inspectors are fully qualified and are therefore helpful to the mine operator in suggesting ways to make their operations safer, there have been instances where individual inspectors have been "vindictive" or "harassing" in their approach.

Certified mine foremen are in critically short supply and the operators suggested two specific changes which would help alleviate the shortage: (1) Reduce the number of years of experience required from 5 years to 3 years on the basis that men are now entering the industry with a much higher level of education than they did when the law was passed; and (2) no longer consider the mine foreman an agent of the Commonwealth subject to both fine and imprisonment.

Also recommended are revisions to the Commonwealth's mine safety and environmental regulations. While there was little disagreement with the intent of these regulations, portions of the regulations need clarified, and made more specific for different types of mines.

Differences between Federal and State regulations require operators tc conform to a double standard with the result that the operator has difficult complying with both. A specific example is the confusion concerning the use of the flame safety lamp and the methane monitor for detecting methane.

Regulations once enacted are difficult to change. Some mechansim should be established which would on a continuing basis review regulations and more revisions as deemed necessary to more effectively accomplish their purpose of improving the health and safety of the miner. Failure to do so weakens the law, causes impediments to progress, and stifles innovations.

TABLE I

SUMMARY OF SALIENT MINING CHARACTERISTICS

Parameter	Deep Mining		Strip Mining	
	Anthracite	Bituminous	Anthracite	Bituminous
Health of Miners	Noise (Some mines have no electric power and must use compressed air	Methane Dust Noise	None	None
Safety of Miners	Flooding Roof Collapse Material Handling Equipment	Flooding Roof Collapse Material Handling Equipment Dust Explosion Methane Explosion	Slope Stability Material Handling Equipment	Highwall Failure Material Handling Equipment
Environmental Impacts	Acid Drainage Subsidence Fires Refuse Disposal Preparation Plant Effluents Impoundment of Tailings	Acid Drainage Subsidence Fires Refuse Disposal Preparation Plant Effluents Impoundment of Tailings	Preparation Plant Effluents Land and Mud Slide Stream Silting Restoration of Site	Preparation Plant Effluents Land and Mud Slide Stream Silting Restoration of Site
Coal Recovery	50-70%	55%	∿100%	∿100%

Every effort should be made to encourage innovations in mining that have the potential for mining more coal safer with less adverse environmental impact through improved mining methods, novel mining machinery and by effective mining regulations reasonably enforced. For example: Alternatives to leaving coal barriers around abandoned oil and gas wells need to be developed to permit more efficient mine planning, allow longwall mining and increase the recovery of coal; the required entry development systems for longwall should be evaluated with the intent of reducing the number from a minimum of three to hopefully one as is the practice in England and Europe; and the need for redundant approvals on modified, new and experimental mining equipment should be studied with the aim to encourage research and development on advanced equipment.

The factors that are likely to constrain coal production significantly in the current decade are: The difficulties in getting assured long-term markets; the lack of qualified miners and supervisors; and the availability of mining equipment. Mine operators have been experiencing shortages of such essential materials as diesel fuel, ammonium nitrate for explosives, and roof bolts; and delivery time on earth moving machinery, mining machines and conveying equipment is not likely to improve.

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TASK FORCE MEETING REPORT

Subject: Coal Preparation

Date of Meeting: February 13, 1974

Date of Rewrite: March 6, 1974; March 18, 1974; March 26, 1974

SUMMARY STATEMENT

The Commonwealth of Pennsylvania is unique among the coal-producing states in that it contains large reserves of coal which can be reduced in sulfur content by using coal preparation, a viable, modern technology with a history of proven accomplishment. Using available techniques and equipment, adequate tonnage of steam coal can be produced at a sulfur level that will meet the Commonwealth's SO_2 emission standards for existing stationary plants; however, it will be virtually impossible to produce adequate tonnage of 1 percent sulfur coal for new power stations as required by Federal regulations.

Further study and research and development is expected to demonstrate that the use of beneficiation techniques will be effective in helping Pennsylvania to achieve good environmental quality and to meet its energy needs during the remaining years of this decade.

RECOMMENDATIONS

1. The Commonwealth of Pennsylvania should immediately initiate a program to promote the widespread application of physical desulfurization to amenable coals by the coal mining industry, using existing coal-cleaning equipment and techniques.*

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* A very similar recommendation on a national basis was made to the Environmental Protection Agency by the Mitre Corporation on Contract No. 68-02-0248.

2. A program should be initiated to compile existing information so as to define the location and characteristics of both the coal being mined and the coal reserves and their potential for upgrading by coal preparation and location of the power plants utilizing these coals, and the sulfur limits under which they must operate.

3. A research and development program directed toward the proper disposal and/or possible use of the waste products from coal preparation plants, and the mines themselves (which always provide some degree of preparation), should be initiated. This effort should be strongly supported.

4. A detailed economic assessment of the benefits that a wide application of presently available coal beneficiation techniques to the coal able to be supplied for use in steam generators should be made. This assessment must delineate and correlate energy losses, coal quality improvement, costs, and environmental impacts.

5. There is a need to study such ancilliary operations to effective fine cleaning as dewatering and moisture reduction, agglomeration and clarification of "black" water.

Research and development of improved beneficiation techniques should be supported on a long-term, low-priority basis.

DISCUSSION

The coals of Pennsylvania have the necessary physical characteristics to make coal washing a logical and meaningful technology for desulfurization--a predominately high pyritic sulfur to organic sulfur ratio with the pyritic sulfur being of a relatively coarse size consist.

A recent U.S. Bureau of Mines study (RI 7633), funded by the Federal Environmental Protection Agency (EPA), showed that the coals of Pennsylvania contained about 67 percent pyritic sulfur, and this is the form of sulfur that

can be removed by physical cleaning. A second U.S. Bureau of Mines study (RI 7231)[2] showed that for coals east of the Rocky Mountains, the average particle size of the pyrite in coal is less than 89 microns. The thirteen Pennsylvania coals in this study had an average particle diameter of 156 microns. If the Pennsylvania coals are removed from the analysis, the average particle diameter of the pryite in the coals studied from the remaining states is 69 microns. This emphasizes the rather enviable position in which Pennsylvania finds itself.

Figure 1 shows the dramatic effect of coal washing on the sulfur content of the principle coalbeds of Pennsylvania

In selected cases, particularly for some of the Allegheny series of coals in Pennsylvania, coal preparation techniques may be used to remove a fraction of the coal which meets or comes close to the EPA restriction of 0.6 lb sulfur per million Btu for new power stations. The balance of the clean coal, somewhat higher in sulfur, could be used to feed existing power stations where the sulfur restrictions are not so stringent. It is not to be inferred that coal preparation techniques are uniformly successful in achieving such significant sulfur reductions and, in fact, such is not the case for, say, the Pittsburgh seam. Still, this favorable circumstance of using preparation techniques to achieve low sulfur levels is a great potential asset to the Commonwealth.

A substantial amount of information on the potential of removing pyrite from Pennsylvania coals was obtained as a result of EPA-sponsored research conducted by the U.S. Bureau of Mines, Commercial Testing and Engineering Company, and Bituminous Coal Research, Inc.[1,3-7] Work undertaken by the Pennsylvania State University and others, also are sources of useful information.[8,9] Much information also exists on power plant locations and fuel requirements, through annual reports prepared by the National Coal Association and the Federal Power

Commission. Much information is available on the coal reserves of the State of Pennsylvania, however, the latest comprehensive compilation comes from a 1928 publication entitled, "Coal Resources of Pennsylvania," by Reese and Sisler. It would appear that up-dating this information and the combining of it with the information on power plants and coal washability into one master plan of coal usage for Pennsylvania, would be in order. To keep abreast of the changing situation, continuing washability studies should be conducted, gaps in information on reserves should be eliminated, and changing environmental regulations and reserve depletion should be taken into account. The initial study could be completed in a period of six months to a year.

In 1971, only 59 percent of Pennsylvania's coal production was "washed" coal, and most of this was earmarked for the production of coke for the steel industry. Of the coal which was strip mined, only 25 percent was washed. The principal use of the Pennsylvania strip coal is for steam production in electric power generating plants or industrial oilers. Generally, washing of this coal will provide a significantly lower sulfur content fuel.

Present equipment and systems for removing impurities from coal are very effective when properly applied and properly used. Methods for cleaning plus 28 mesh coal are generally inexpensive while methods for cleaning finer sizes of coal are more involved and significantly more expensive.

Equipment manufacturers and designers are continually improving present circuitry and technology. However, the coal preparation process creates "dry" and water-borne waste streams at the mines and these will have to be given careful attention to prevent environmental pollution. As additional coals are cleaned in the fine sizes, tailing ponds or impoundments of water and minus 28 mesh refuse will be created. It is imperative that new methods of disposing of this material be found.

Despite the fact that Pennsylvania coals generally are amenable to significant sulfur reduction through coal preparation, adequate tonnages of 1 percent sulfur coal cannot be produced. However, it is possible that the Federal standards are overly stringent and should be relaxed for new power plants constructed at sites removed from highly populated areas. In this case, coal preparation technology can provide a reasonably low sulfur content fuel, in the range of 1.2 - 1.6% sulfur, at a minimum cost in the shortest time.

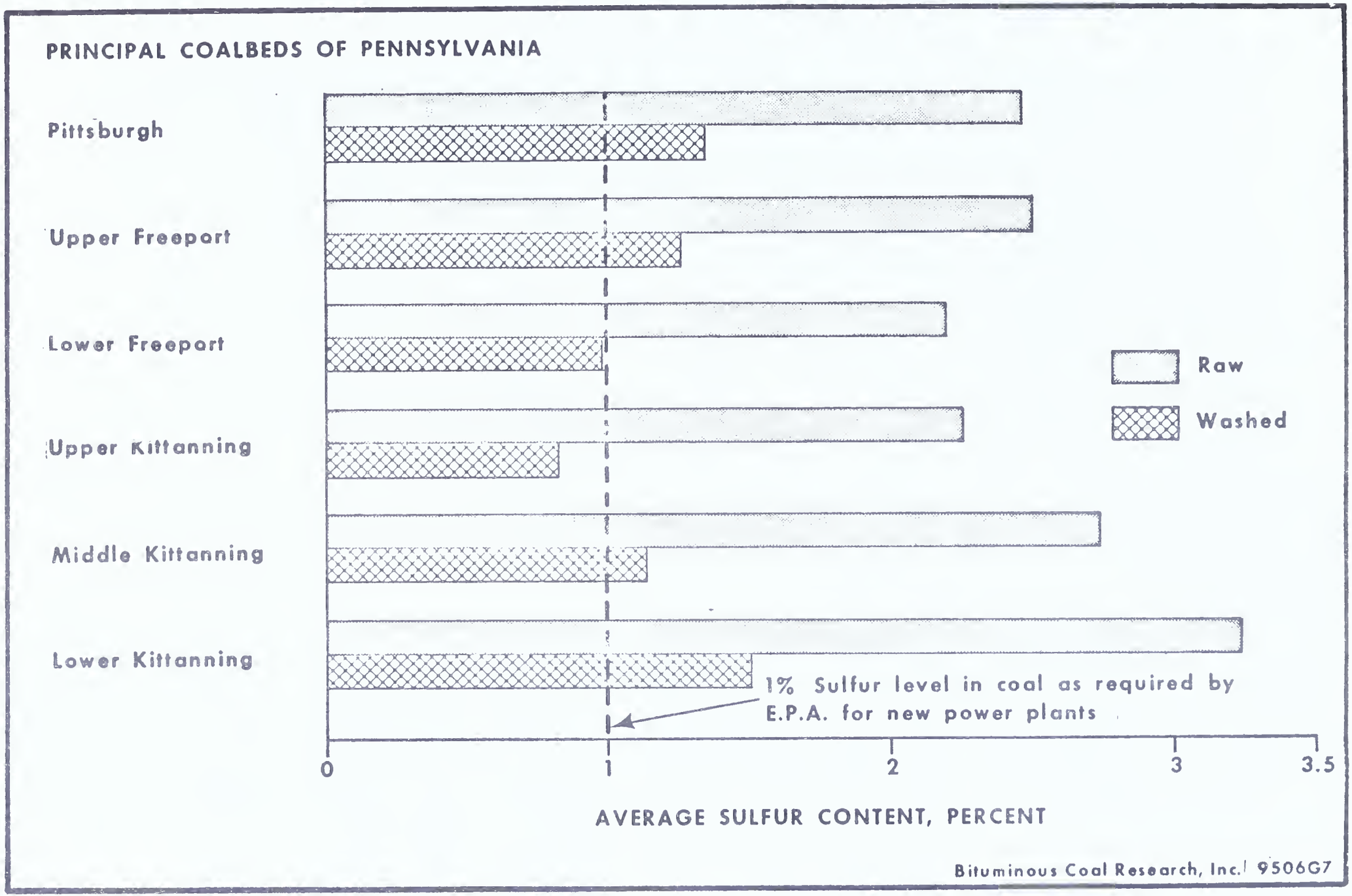

Figure 1. Washability of Pennsylvania Coals at 3/8 Inch × 0 Size and 80% Yield (USBM-RI-7633)

COAL PREPARATION (BENEFICIATION) TASK FORCE

February 13, 1974

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EXPANSION OF PENNSYLVANIA COAL UTILIZATION IN THE 1970's

TASK FORCE REPORT NO 3
"COMBUSTION TECHNOLOGY"

Summary Statement

Combustion technology is relatively well established, with applicable equipment having been used during the last century. Attention is now being directed again to the use of stoker furnaces and various types of gasifiers, particularly for medium-size industrial applications which are permitted to burn coal with a fairly high sulfur content under current regulations. There are severe problems with equipment availability, however, since most of the facilities for manufacturing these types of equipment were scrapped many years ago. There is also some uncertainty as to how well various types of coal will perform in different devices, including improved designs now being developed. Thus, although the overall technology is highly developed, it should not be regarded as completely proven until demonstration projects are operated successfully for a period of several months.

RECOMMENDATIONS

1. Encourage and support the investigation of the performance of gasifiers ("demonstration" projects), both the types formerly used and new types (e.g., fluidized bed).

2. Encourage and support further research into the operational mechanisms of gasification as a basis for rapid further development in size, efficiency, and design.

3. Encourage coal producers or others to market "graded" coal (uniform in size, quality, etc.) for small and medium-size users.

4. Provide assistance to users in procuring coal burning equipment, identify supply "bottlenecks".

5. Assist in the establishment of a program for training operating personnel.

INTRODUCTION

There are two basic approaches to the combustion of coal: direct firing and indirect firing. Both methods have been in use for more than a century. Direct firing refers to the burning of coal directly in the equipment where the heat is desired, such as a boiler, while indirect firing refers to production of a "clean" (pollution-free) gaseous fuel which can be used to produce heat in a separate device. As small and medium-size users turned to the use of fuel oil and natural gas, particularly during the past 20 years, the market for coal-fired equipment virtually disappeared, and manufacturers discontinued production of the equipment. In many instances, they disposed of the patterns, fixtures and other facilities for manufacturing the equipment. Large users of coal, such as electric utilities, have continued to use this fuel and large and efficient boilers have continued to be developed.

Today, in the context of rising demand for energy in the face of steady or diminishing gas and oil supplies, interest in small and medium-size coal-fired equipment is being resurrected. Schools, hospitals, laundries, industrial plants, brick and glass manufacturers, etc., constitute a significant potential market for coal. Although there is the need to be concerned about pollution levels from these devices, the regulations are less stringent for combustion units with firing rates less than 2 billion Btu/hr; for a firing rate less than 50 million Btu/hr the allowable sulfur content of the coal is about 2.4% in all areas except in four air basins where the limit is about 0.6% S in the coal.[4] Significant amounts of coal of this quality can be obtained by proper "washing" of the raw coal at the mine.* Also, many of the gasifier systems being developed incorporate processes for removing the sulfur from the product gases.

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* Refer to the report by the Coal Preparation Task Force

Table 1 summarizes the state-of-commercialization of the various coal combustion methods.

Direct Firing

Proven furnace designs are available to handle all types of coal for small and medium-size applications,[2,6,7] in addition to the well established technology of the large electric utility applications. A disadvantage is the need to use relatively low sulfur coal, or coal cleaning, or stack gas clean up. The advantage is the relative simplicity and versatility, and higher thermal efficiency, in comparison with gasifiers. A more recent development is the fluid bed, either ballasted (which is not yet commercial) or unballasted ("Ignifluid") which is commercial. Commercialization of the ballasted fluid bed can be expected within the next few years. A variant of the unballasted fluid bed is the "fast-fluid" bed. One example of this is the Szikla-Rozinek combustor which has been successfully demonstrated and tested. Another attractive alternative is the direct firing of coal using an ultra-fine grind, if suitable methods of cleaning the coal to acceptable levels can be developed.

For the large user (e.g., the electric utility), the matter of equipment procurement presents no problems because there currently is an active market. As mentioned above, the situation with regard to obtaining furnaces for the small and medium-size users is rather poor because the market has all but disappeared during the past several years. Although some equipment supply problems are anticipated, their severity cannot be accurately gauged: the reappearance of a market may provide the necessary incentive to produce the equipment on a large scale by one or more manufacturers. A more fundamental problem is that of lead-time: steel component deliveries from mills and foundries are quite long (12-20 months).

Gasification

Providing that the proper funding is provided, it appears reasonably certain that the next five to ten years will see the re-deployment of low-Btu gas producers using coal.* By "low-Btu gas producer" is meant a

* The technology for producing a high-Btu substitute natural gas from coal is about 5 years behind the low-Btu technology, and therefore was not considered by this Task Force.

device that converts coal or other solid fuel into a gas by partial oxidation with air and/or steam and/or oxygen, leaving only mineral matter or ash as solid residue (so-called "total gasification"). The principal constituents of the product gas are: carbon monoxide (CO) and hydrogen (H_2) as the most important combustibles with methane(CH_4) in some designs; and nitrogen (N_2) and carbon dioxide (CO_2) as the most important incombustible diluents. The calorific values range from 100 to 300 Btu/cubic foot.

The simplest unit, developed more than a century ago, is a vertical shaft of 2 to 12 ft. diameter containing the fixed coal bed resting on a grate, fed from the top, and blown with air from the bottom. The product is Producer Gas, mainly CO and N_2, of 100 to 150 Btu per cubic foot heating value.[1] The use of moist air, or the addition of steam increases the Btu value by adding hydrogen. The Btu value is further increased by the use of oxygen to cut down on nitrogen, with the heating value rising to 300 Btu per cubic foot.

The relatively low heating values (100 to 300, compared with 1000 Btu for natural gas) make it unsuitable for pipeline transmission over any distance. Gas producers must therefore be used on site: traditionally they are constructed alongside the furnaces to be fired, with a roughly one-to-one match between the furnace demand and the gas producer capacity. It is possible, however, to use the gasifier as a constant rate, base supplier, with a supplementary fuel used where greater furnace outputs are desired.

The use of oxygen to increase the gas heating value increases the space requirements, the capital investment, the mechanical complexity and sophistication of design, and possibly the level of operator training required. Economics then demands increased unit size, and higher Btu production per unit of reactor volume. This is more easily met by fluid bed and entrained bed gasifiers than by fixed-bed, shaft gasifiers. Larger units are able to serve more furnaces, but then have to be sited further away from the point of use.

These different requirements indicate the probable development of two partly overlapping market sizes, with small companies needing one or a handful of cheap air-blown shaft producers of around 50 million Btu per hour capacity per unit, and large companies or groups of companies setting up steam and oxygen-blown "central" gas producers of 500 million Btu per hour capacity per unit, or higher in the future, of fluid bed or entrained particle design, and possibly pressurized.

The market suitable for total gasifiers would appear to be restricted mainly to industrial uses -- process heat (furnaces) and production of process steam. They will also be suitable for the first generation of combined-cycle electricity generators based on the producer-gas-fired gas turbine. Central station boilers fired by pulverised coal (or other conventional fuel) are about one to two orders of magnitude larger than existing commercial gasifiers. Use of gasifiers to fire large utility boilers is questionable if not inappropriate at present. Scale-up of fixed-bed shaft gasifiers to such a size is thought to be impossible; only fluid or entrained particle gasifiers would be suitable. The alternative to a single gasifier or a handful feeding a single boiler would be a large multitude: 20 to 200.* A number of utilities(e.g., TVA, Comm.Ed., Penelec) are planning to construct and operate gasifier-based electric generating "demonstration" plants in the 50-100 MW size range, however.[8]

Recently, a National Academy of Engineering -- National Research Council evaluation panel recommended to the U.S. Office of Coal Research that the federal government spend an average of $60 million per year for five years to get one or more of the 20 or so gasifier processes completely "commercialized." The panel affirms that the base technology is available, and what is needed is the design, construction and operation of demonstration projects.[5]

This evaluation may tend to be too pessimistic, however. Task Force participants were unanimous in their opinion that three processes are already commercialized: Lurgi, Wellman, and Koppers-Totzek. It was also

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* The capacity of fixed bed gasifiers can be increased by operating at pressure (eg. the Lurgi at 300 psi), but this is only appropriate to gas turbine, combined cycle operation, not for firing a normal pressure boiler.

agreed that all three processes could be improved, and that the construction and operation of some demonstration units was needed to establish the market. A contract has been let by one participant for a unit,[9] and another participant indicated that a contract for the construction of his organizations process was imminent.[10] In all cases, however, as with the direct-firing furnaces, delivery delays are to be expected owing to backlogs in the various manufacturing facilities.

Fuels suitable for gasifiers depend on the type. The most suitable fuels for shaft gasifiers are anthracite and coke. Bituminous coals of low swe ling index can also be used but this introduces further complications of tar handling. Fluid bed and entrainment gasifiers, on the other hand, can use a complete range of coals, and tar production may be reduced or eliminated: they can also be used for gasification of liquids and reforming of other available gases.

The potential for gas cleaning derives principally from the form in which the sulfur appears in the products gas. This is hydrogen sulfide (H_2S) for which commercial methods available for removal exist. At the same time, the gas can be cleaned of particulate matter to the extent desired, yielding a clean but generally cold gas. The usual need to cool the gas for cleaning (with hot gas cleaning under development) reduces the thermal efficiency from 80 to 90% when used hot down to 70 to 75% available cold. For this reason low sulfur anthracite is a preferred fuel, if available, as the off-gas is then usable hot without further clean-up if the process being heated is not sensitive to ash carry over.

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TABLE 1

COAL COMBUSTION METHODS

	Commercial
I. Direct Firing:	
1. Grate firing	Yes
2. Crushed firing - Fluid bed	No
Ignifluid	Yes
Szikla-Rozinek (fast fluid bed)	No
3. Ground - standard pulverised coal combustion	Yes
4. Ultra-fine grind	No
II. LOgas: Producer-gas/water-gas (CO, H_2, N_2,); (100 to 300 Btu/Cu.ft.)	
1. Fixed bed, vertical shaft (Wellman, Lurgi) - counterflow	Yes
2. Fluid or fast fluid bed	No
3. Entrained (fine grind: Koppers-Totzek)	Yes

Note (1): Units can in principle be atmospheric or pressurised
(2): Producer gas is continuous; water gas may be intermittent
(3): Sulfur is removed as H_2S by standard cleaning methods
(4): Gas can be delivered hot with S and ash, or cleaned, cold
(5): Efficiencies are 85 - 90% used hot; 70 - 75% cold and clean

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Pennsylvania Task Force Report on
Tall Stacks and Supplementary Controls

Summary Statement

THE USE OF TALL STACKS AND METEOROLOGICALLY-BASED EMISSION LIMITATION SYSTEMS, TOGETHER WITH OTHER MEASURES WHICH CAN AND SHOULD BE TAKEN, CAN HELP MEET AIR QUALITY AND ENERGY NEEDS FOR PENNSYLVANIA IN THE 1970's.

Introduction

This report represents a summary of the views of a task force of Pennsylvanians who met in Harrisburg on February 8, 1974 to consider the use of tall stacks and meteorologically-based emission control systems (i.e., supplementary control systems). Such a technology, if effective and if implementable, would allow the continued combustion of coal in large utility and industrial boilers in Pennsylvania.

This report addresses a number of questions associated with the tall stack/supplementary controls technology, reviews the current state-of-the-art of the technology, and details research priorities.

Discussion

Tall Stacks or Scrubbers?

The use of tall stacks (permitting the release of pollutants from a high level to obtain enhanced dispersion) and supplementary controls (using low sulfur coal or reducing power output when meteorological conditions limit effective plume dispersion) is highly controversial. On the one hand, these techniques have proven successful, at relatively low costs, in reducing the ground-level concentrations of sulfur dioxide (SO_2) in the vicinity of power plants burning high sulfur coal.[1-3] On the other hand, the use of these techniques provides, on the long-term average, only a negligible reduction in the amount of pollutants emitted. Principally for this reason, the Environmental Protection Agency (EPA) "...considers constant emission reduction techniques, such as flue gas desulfurization,

far superior to dispersion techniques and has proposed regulations that limit the use of such dispersion techniques to situations where constant emission reduction controls are not available."[4]

The Task Force did not attempt, however, to compare or contrast the merits of tall stack technology versus flue gas desulfurization (FGD) technologies. Tall stacks were considered to be an important technological option, partially because complete implementation of scrubber systems appears to be some years away.* Given limitations on the availability of FGD systems and low-sulfur fuels over the next few years, the difficulty in retrofitting some facilities with FGD systems, and distribution/allocation problems associated with low-sulfur fuels, a majority of Task Force members viewed the tall stack/supplementary controls technology as an important interim control measure for Pennsylvania. Faced with pressing environmental and energy resource needs, Pennsylvania should be open to implementing a mix of control technologies, rather than relying solely on any one technology.

How Effective Is the Technology?

There appears to be little controversy over the effectiveness of this technology in reducing average ground-level SO_2 concentrations resulting from power plant emissions. Here, the simple construct of Clarke, Lucas, and Ross[5] (Figure 1) is instructive. Consider the geometrical model shown in the figure; the cross-section of the plume is drawn where the lower edge first touches the ground (plume radius equals effective height of emission, H). Now, if the wind speed is u m/sec, the air flow through the cross section is $\pi H^2 u$ m^3/sec. The air flow contains all the pollutant emitted from the source, say Q m^3/sec. Then, the average volumetric

*In a recent report,[4] EPA declared that the "...last scrubber needed by coal-fired power plants to meet primary ambient air quality standards can be installed sometime in 1978." However, this analysis did not consider scrubber needs for oil-fired plants, for large industrial boilers, or for gas-fired plants expected to switch to coal; the analysis also assumed that power plants having an impact on primary standards would have priority in the distribution of low sulfur fuels and FGD systems. Under these circumstances, the 1978 date appears overly optimistic.

concentration of pollutant over the cross-section is

$$\frac{Q \times 10^6}{\pi H^2 u} \text{ ppm.}$$

Hence, as effective stack height, H, is increased, ground-level concentrations decrease as the square of the effective stack height.

Although instructive, the geometric model used above is crude; better models have been developed and are in current use. For example, TVA's comparison of estimated maximum surface concentrations associated with different meteorological dispersion conditions and stack heights between 60-300 meters is shown in Figure 2.[6] Three critical meteorological conditions are depicted: coning, inversion breakup, and limited layer mixing (trapping). Note for coning and inversion breakup conditions, the inverse relationship between stack height and concentration applies. For trapping conditions, concentrations are primarily determined by the elevation and magnitude of the subsidence inversion or stable layer aloft; stack height does play a role if the plume penetrates the stable air and is not trapped below it (concentrations for these cases are approximately zero and are not shown in Figure 2).

Effectiveness of the tall stack/supplementary controls technology can also be demonstrated by air quality measurements. Table 1 shows data reported by EPA[7] from a copper smelter in the Puget Sound, Washington area:

Table 1. One-Hour SO_2 Concentrations, Copper Smelter Area

Time Period	$SO_2 > 0.25$ ppm	$SO_2 > 0.50$ ppm
1969	102 times	25 times
1972	7	1
1973 (5 months)	1	0

The data are from a continuous monitoring station operating since 1969, before the advent of supplementary controls by the smelter; meteorologically-based controls were introduced at the smelter in 1972. Table 2 depicts a similar trend in

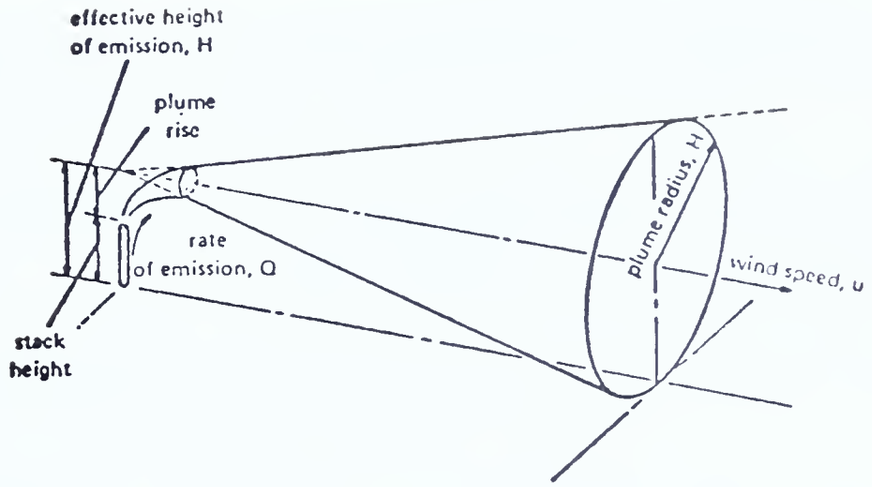

Figure 1. Simple Cone Model of Plume Dispersion (Ref. 5).

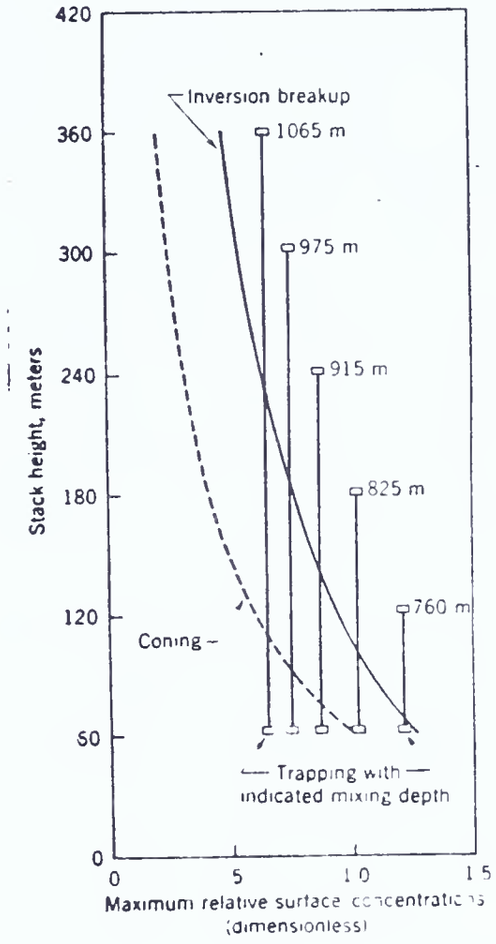

Figure 2. Maximum Relative Concentration as a Function of Meteorological Conditions and Stack Height (Ref. 6).

concentrations from a set of 14 monitoring stations associated with TVA's Paradise Steam Plant: [1]

Table 2. Concentrations Above SO_2 Standard Levels, Power Plant Area

Time Period	Above 3-hour Standard (0.5 ppm)	Above 24-hour Standard (0.14 ppm)
1/1/68 - 9/19/69 (Before Control)	10	8
9/19/69 - 6/25/71 (After Control)	2	0

The time periods shown are for periods before and after supplementary controls (i.e., power reductions) were used to control peak concentrations; note that the average SO_2 emission rate for the "after" period was 50% greater than the rate for the "before" period, due to start-up of a third generating unit. Stack heights for the two older generating units are 600 feet; for the newer unit, 800 feet.

Environmental Impact of the Technology

Given the effectiveness of SO_2 concentration control by the technology, tall stacks and supplementary controls could be viewed as an alternate means of attaining and maintaining ambient air quality standards (AAQS), rather than relying solely on FGD systems or low-sulfur fuels. However, other environmental effects associated with the technology must be considered before such a conclusion can be reached.

This technology relies on dispersion (i.e., dilution) to reduce ambient concentrations; on a long-term basis, pollutant loadings vented to the atmosphere are only negligibly reduced.* Possible environmental effects associated with these unchanged atmospheric loadings form the basis of the controversy regarding the use of tall stack technology. These effects include [7,8]:

- impact of suspended sulfate formation.
- impact of heavy metals emissions.
- impact of acid rainfall.

*Clearly, on a short-term basis during periods of critical meteorology, atmospheric emissions are significantly reduced, either as a result of power output reductions or through use of lower sulfur coals.

- impact of acidification of soil and water.
- impact of visibility reduction due to aerosol formation.
- impact of changes in the colloidal stability of clouds.
- impact of changes in the transmission of radiant energy through the atmosphere.

Unfortunatcly, most of these impacts are unquantified at present. Acceptance of the tall stack technology, therefore, rests rather subjectively on an evaluation of the risks and uncertainties associated with the potential environmental impact due to these effects.

As an example, a crude delincation of risks associated with suspended sulfate formation can be made. Kellogg, et. al.[9] have summarized atmospheric sulfur reactions (Figure 3). Sulfur dioxide is a product of the oxidation of H_2S and also constitutes about 95 percent of the sulfur compounds resulting from the combustion of fossil fuel; sulfates or sulfuric acid arc then formed as further oxidation products. Rates of conversion of H_2S and SO_2 to sulfatc particles in polluted as well as unpolluted atmospheres are uncertain, but may be rapid. Combustion sources are thus sources of the primary pollutant, SO_2, which in turn is a precursor of the secondary pollutant, particulate sulfate. Note that sulfate and SO_2 ambient concentrations do appear to be correlated, at lcast in urban atmospheres, as shown by Altshuller (Figure 4).[10] A saturation effect for sulfate concentrations in the higher SO_2 concentration range appears; hence reduction of SO_2 by 70 per cent from 200 to 60 $\mu gm/m^3$ results in only a 20 per cent reduction of sulfate at a statistically average site, from 17 to 13.5 $\mu gm/m^3$.

If current evidence between some types of morbidity and sulfate concentrations at the 8-12 $\mu gm/m^3$ level proves accurate[10], and if the statistical relationship shown in Figure 4 is correct, stringent levels of SO_2 control (20-50 $\mu gm/m^3$) will be required. Under these circumstances, use of tall stack tcchnology would then be questionable, especially if current sulfatc concentrations at rural sites could be attributed to chemical conversion of sulfur dioxide during transport downwind

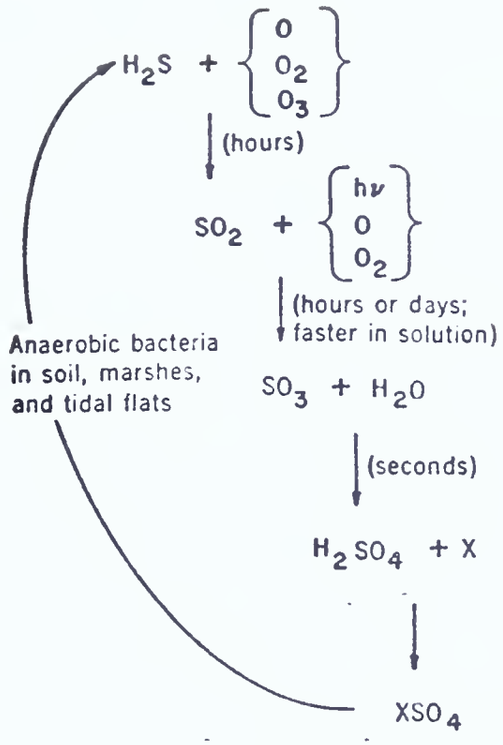

Figure 3. Chemical Processes Involving Environmental Sulfur, with Indications of Mean Lifetime of Each Compound (Ref. 9).

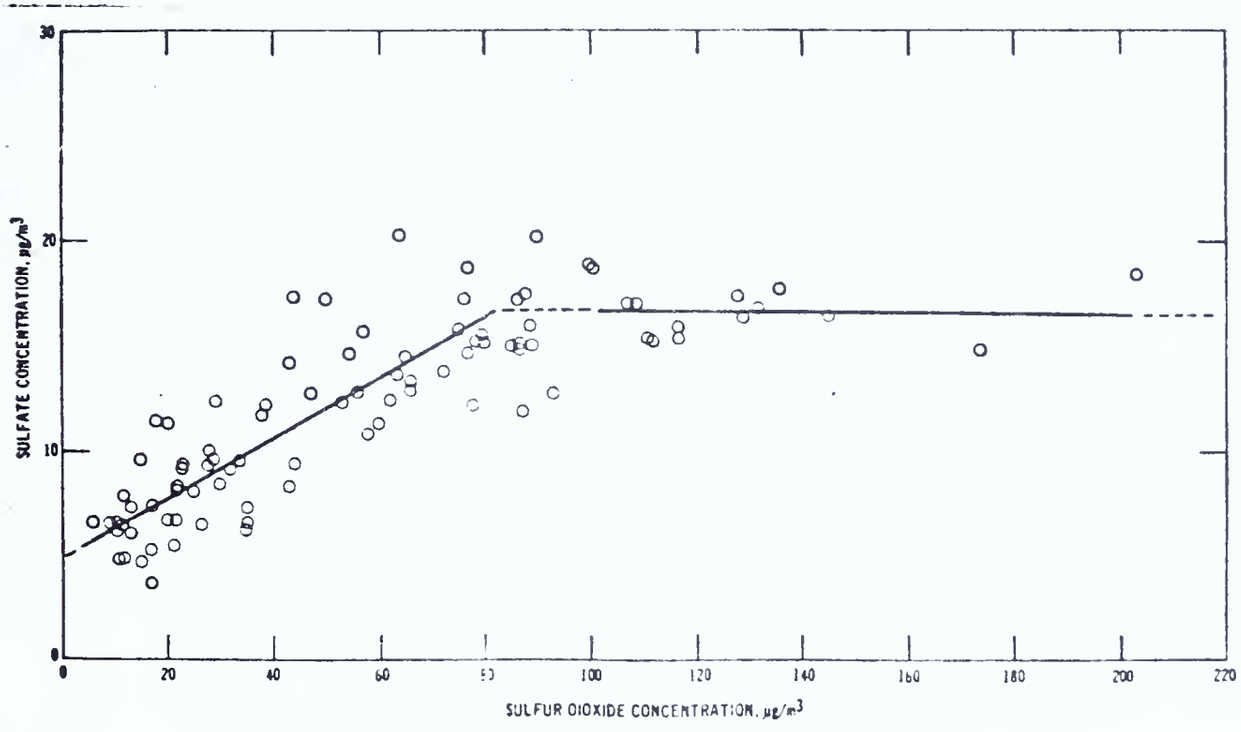

Figure 4. Relationships between Annual Average Sulfur Dioxide and Sulfate Concentrations for 18 U.S. Cities (Ref. 10).

from urban areas. On the other hand, the evidence avaiable to date is incomplete, a difficult base for public policy. Altshuller's conclusion after analyzing available SO_2-sulfate data bears repeating for many of the impacts listed on pages 5-6: "... The complex relationships between urban sulfur dioxide to urban and non-urban sulfate make urgent a better understanding of the atmospheric chemistry of these sulfur compounds. Without such experimental results, it will be impossible to ... develop an air pollution control strategy for atmospheric sulfates..."(10)

Costs

Capital and operating costs to implement the tall stack/supplementary controls technology are signficantly less than costs associated with implementation of FGD systems. For example, estimated capital costs associated with implementing this technology at 9 TVA coal-fired plants are $50 million dollars. This includes costs for development and installation of emission limitation programs and monitoring networks ($4 x 10^6), costs for erection of 3 additional 800 - 1200 foot stacks ($ 38 x 10^6), and costs for coal switching capability at 3 plants ($8 x 10^6). Annual costs for operation and maintenance of the system are estimated at $9 million dollars, including annualized capital charge costs ($5 x 10^6), operation and maintenance charges ($2.5 x 10^6), and incremental costs of low sulfur coal ($1.5 x 10^6). These costs can be compared to TVA's estimated capital ($42 x 10^6) and annual operating ($3.8 x 10^6) costs for a FGD system on one generating unit of the Widows Creek plant."

Conclusions and Research Priorities

Given the unquantified, but potentially important nature of many of the environmental impacts of tall stack usage, a number of caveats concerning use of this technology would appear to be in order:

(1) Any use of the tall stack/supplementary controls technology ought not be at the expense of discouraging other techniques and technologies, notably FGD systems and coal preparation techniques.

(2) The tall stack/supplementary controls technology should be viewed for the present as an interim measure which will allow quick attainment of SO_2 AAQS, until definitive evidence on secondary environmental impacts is obtained.

(3) Active research and investigation into environmental impacts associated with tall stacks should be supported (for example, investigations concerning morbidity and mortality effects associated with specific sulfate concentrations). This research should be supplemented by increased ambient monitoring of sulfate levels, heavy metal levels, etc.

(4) Current successful applications of the tall stack/supplementary controls technology are limited to rural locations, where unique source-receptor relationships can be assumed. If the technique is to be implemented in multiple-source regions, research to link individual sources with specific ambient concentrations must be completed. Such research would not only insure the reliability of supplementary controls but also safeguard legal enforceability of these intermittent emission limitations.

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EXPANSION OF PENNSYLVANIA COAL UTILIZATION IN THE 1970's

TASK FORCE REPORT NO. 5

"FLUE GAS DESULFURIZATION"

Summary Statement

Reliability of flue gas desulfurization (FGD) systems for the electric utility industry has not been demonstrated sufficiently in the United States to justify installation of the equipment on all coal burning boilers in Pennsylvania. Further the task force believes that equipment and material supply problems will make it impossible to install many FGD systems within the next 3-5 years. Alternative means for meeting sulfur dioxide ambient air quality standards, such as tall stacks and intermittent control systems, should be used as an interim measure pending the successful completion of some of the demonstration programs now underway, especially those programs other than lime/limestone scrubbing.

Recommendations

1. Steps should be taken to allow the use of alternative control measures for meeting the primary air quality standards. The use of tall stacks, intermittant control systems, and coal cleaning have shown their ability to be an effective means for controlling sulfur oxide emissions.

2. Relaxation of compliance schedules should be made to allow time for further improvement in FGD system reliability.

3. As an incentive to install FGD systems, the State public utility commission should be urged to treat increased costs from FGD control in the same manner as increased fuel costs are treated.

4. More formal procedures should be developed to provide for unpreventable malfunction of the FGD system.

5. Research and development work is required to determine the effectiveness of sludge disposal systems. An air pollution problem should not be traded for a water pollution problem.

6. A sulfur oxide control committee should be established to follow the work of others and keep the Pennsylvania utilities informed of advancement in FGD technology.

7. The movement of supplies and materials should be coordinated and expedited to obtain maximum efficiency in installing control measures.

8. Educational programs should be developed to train personnel for operation of these FGD systems.

Potential SO_2 Control Processes

A major division in FGD equipment design is between recovery of SO_2 in useful form, and formation of a solid waste. Both the recovery and throwaway methods can be carried out in either wet or dry systems. Throwaway methods may convert an air pollution problem to a water pollution or solid waste disposal problem. The recovery methods require the utility or its agent to market a chemical product.

The technologies for SO_2 removal include more than 50 individual processes commonly known in the United States. However, any process to be commercially applied in the near future must meet the following criteria:

1. Technical feasibility
2. Economic feasibility
3. Advanced state of development
4. Acceptable reliability
5. Marketable end product for recovery processes
6. Solvable process problems
7. Acceptable solid waste disposal

Some processes are "add on" types. These can be installed at a point where the gas has passed through all the equipment and is about to enter the stack. Another type requires higher temperature and usually is inserted ahead

of the air heater. For retrofit, this involves the cost and time for cutting into the gas train, resizing or eliminating the precipitator, plus the introduction of uncertainties regarding the effects on primary plant operation. Thus, add-on types are more apt to be considered for existing plants.

Seven processes have gained some degree of utility company acceptance.

1. Wet lime/limestone scrubbing
2. Alkali scrubbing, no regeneration
3. Alkali scrubbing with calcium regeneration
4. Alkali scrubbing with thermal regeneration
5. Alkali scrubbing with electrolytic regeneration
6. Magnesium oxide scrubbing and regeneration
7. Catalytic oxidation

All except catalytic oxidation use a wet scrubber. Catalytic oxidation is a high temperature process requiring reheat on a retrofit installation, which is a disadvantage, but not a controlling factor during the search for a process that works. Most of the methods that have advanced to the demonstration stage (trial installation of one or more modules at an operating power plant) have used calcium oxide (lime or limestone) wet scrubbing.

FGD Equipment Reliability Not Established

Although 85-90% removal of sulfur by FGD has been achieved in some installations, EPA's position on equipment reliability was heavily criticized by some task force members.

Table 1, reproduced from the EPA report, summarizes the operating experience data on which EPA bases its conclusion that FGD reliability has been established. Of the seven plants listed, four reported no serious problems in regard to scaling, plugging, erosion, corrosion, reheater, and mechanical components. One reported mechanical problems that may be irrelevant to FGD reliability, and two reported problems relevant to FGD. There were a number of unsuccessful FGD experiments that the EPA report did not quote.

Of those reporting no serious problems, only three burned coal. One of these, the Mitsui plant using Chemico (U. S. technology) equipment is in Japan, and one, TVA's Shawnee plant, a pilot plant of about 10 megawatts capacity, exhibited minor erosion/corrosion problems. The most optimistic of the utilities, according to the EPA report, was Louisville Gas and Electric Company, which indicated that only a few more months of operation of their Paddy's Run Station is required prior to commitments to full commercial-scale systems. As Table 1 shows, this station has been operating for only a year so far.

The EPA report discussed areas of "non-relevancy" brought up by several utility witnesses in regard to the Mitsui plant. One of these, the use of carbide sludge for calcium hydroxide at Mitsui, instead of burnt lime which would be used in the U. S., was regarded by several witnesses as making no important difference. Two other items, base load operation at Mitsui which does not represent widely varying loads to be expected in many applications, and open-liquor-loop operation at Mitsui leading to unacceptable water-pollution problems, were refuted by the testimony of only one witness.

The EPA conclusion that FGD is reliable is based on the availability of solutions to the various problems that have been encountered, as well as the successful operations cited in the EPA report. But in fact, the only coal-burning FGD operation under U. S. operating conditions that has not exhibited at least minor FGD-related problems still requires several more months of operation before being considered commercially acceptable.

Under these circumstances, the evidence supports sufficient optimism to justify undertaking definitive demonstrations in which the solutions are all simultaneously applied. However, in scaling up from pilot plants to larger demonstrations and finally to full scale test, the practice usually considered prudent, would require a period of full scale experience, test, and demonstration that has not yet been completed in this country.

Other Problems with FGD

A number of other problems were cited in criticizing EPA's position. For example, FGD systems require an additional 4 to 6 percent of the thermal energy at the power plant, and also require energy for mining and transporting additional materials (coal and lime/limestone). These additional drains on the nation's available energy supplies are viewed as a serious problem, considering the energy shortage existing in the 1970's.

Disposal of wastes resulting from FGD operations was considered a serious problem, requiring more development than appears to be recognized in the EPA report. Industrial and municipal wastes are becoming increasingly difficult to dispose of in environmentally acceptable ways as suitable landfill areas become more scarce and more distant.

Another problem raised was the availability of trained operators with adequate chemical engineering backgrounds to operate and maintain FGD systems of the required size and number. Clarification was called for in state regulations regarding liability of utility companies in the event of FGD system malfunctions. The state was also called upon to provide the means to recover the cost of FGD equipment, perhaps exceeding 10% of the cost of a new plant, and a much higher percentage of the original cost of an old plant, possibly through increased rates;

and also to establish priorities in installing equipment, which will probably not be available in sufficient quantities to make possible all the installations required by regulations. Until these problems are solved, it seemed premature to require a large number of FGD installations.

Costs

Testimony at the EPA hearings pointed out that capital costs for retrofitting FGD systems on existing plants ranged from as low as $39 per kilowatt to as high as $108 per kilowatt. Most estimates fell in the range of $50 to $65 per kilowatt. Capital costs for new plants were generally lower.

Annual costs for retrofitted plants ranged from 2.4 mills/kw-hr to a high of 10 mills/kw-hr, with most plants falling in the 2.4 to 4.0 range. Only two estimates of annual costs for new plants were given -- EPA's estimate of 1.5 mills per kw-hr and Ohio Edison Co.'s estimate of 2.7.[1] Duquesne Light Company estimates much higher costs, however.[2]

Participation by Industry

Many industrial organizations in Pennsylvania are participating in programs directed toward the development of FGD equipment and other approaches to reduce sulfur emissions. Glass companies, for example, were reported to be trying lime injection downstream of the furnace, followed by bag-house filters. Pennsylvania Power and Light Company is working with the burning of anthracite (low-sulfur, but high-ash coal) using bag-house filters. The Philadelphia Electric Company is installing a demonstration SO_2 scrubber

system, using magnesium oxide, at its Eddystone Plant. The Duquesne Light Company has installed a wet scrubbing system at its Phillips Generating Station, and plans a similar installation at its Elrama Station. Duquesne has spent $50 million on this program, and has not yet achieved successful operation of the equipment, having experienced the full gamut of problems: late delivery of equipment, defective equipment when delivered, need for re-design of the system, poor labor productivity during the installation, difficulty with scheduling plant shutdown to accomplish the tie-in, corrosion of pumps, piping and tanks, leaks in the gas circuits, significant scaling and deposit build-ups on components, and the lack of a suitable sludge disposal method.

Alternative Technologies

Methods that should ultimately help to reduce sulfur in stack gases include coal gasification* and removal of sulfur during coal preparation before it is burned.+

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* Refer to the report of the Combustion Task Force.

\+ Refer to the report of the Coal Preparation Task Force.

Research results and test data on plants equipped with FGD systems are now being awaited. An advanced dry system yielding elemental sulfur has been proposed for demonstration. All these are likely to be developed after the mid-1975 compliance date. Measures such as tall stacks and operational controls were urged pending these developments, in preference to requiring installation of present state-of-the-art FGD equipment.++ It is recognized that this approach does not reduce sulfur emissions, but the task force recommends that it does represent a suitable interim approach, since with it AAQ standards can be met.

In addition, many Pennsylvania coals can be suitably cleaned prior to combustion to remove pyritic sulfur. Full use of preparation plants should be investigated.

References

1. "National Public Hearings on Power Plant Compliance with Sulfur Oxide Air Pollution Regulations," Report of the Hearing Panel, U.S. Environmental Protection Agency, Washington, D. C. (January 1974).

2. Statement by S. L. Pernick to the EPA on November 26, 1973.

3. "World Status of Flue Gas Desulfurization," by A. V. Slack, November 29, 1973.

++ Refer to the report of the Tall Stacks and Supplementary Control Task Force.

Table 1**

FGD OPERATING PROBLEMS AND THEIR RESOLUTIONS AT VARIOUS PLANTS*

Problem	JSR Chiba Plant	Comm. Ed. Will County	Mitsui Chemico Plant	Boston Edison Mystic	EPA Shawnee	K.C.P&L LaCygne	Louisville G&L Paddy's Run
Chemical scaling	No	Minor	No	No	No	Minor	No
Demister pluggage	No	Yes	No	No	No	Yes	No
Wet/dry pluggage	No	No	No	No	No	No	No
Erosion/corrosion	No	Yes	No	Minor	Minor	Yes	No
Reheater problems	No	Yes	No	No	No	Yes	No
Mechanical problems (Fans, pumps, dryers, etc.)	No	Yes	No	Yes	No	Yes	Minor
Date started up	July 1971	Feb. 1972	Mar. 1972	Apr. 1972	Apr. 1972	Feb. 1973	Apr. 1973
Process	sodium scrubbing and regeneration	Limestone	Lime	Magnesium oxide	Limestone & lime	Limestone	Carbide sludge
Oil or coal	Oil	Coal	Coal	Oil	Coal	Coal	Coal
Size, megawatts	75	156	156	150	3x10 Mw	840	70
Testimony	S. Watt, Davy Powergas, pp. 2426-2450	B. Lee, Comm. Edison, pp. 2067-2206	H. Hesketh, So. Ill. Univ. pp. 2741-2765	W. Irving Boston Ed., pp. 1356-1388	F. Princiotta EPA, pp. 35-110	D. McPhee, KCP&L, pp. 1430-1451	J. Mayrose LG&E, pp. [illegible]

* Yes or No indicates whether problems were considered serious at time of hearing.

** From EPA Hearing Panel Report (Reference 1)

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